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QUEEN AND DUKE PATRONS OF TENTH WORLD'S POULTRY CONGRESS

Her Majesty the Queen and His Royal Highness the Duke of Edinburgh have been graciously pleased to become patrons of the Tenth World's Poultry Congress which is to be held in Edinburgh from August 13 to 21, 1954. The Honorary President of the Congress will be the Secretary of State for Scotland. The Congress, which is being held under the auspices of the World's Poultry Science Association, is being organized by the Department of Agriculture for Scotland with the full co-operation of the poultry industry.

The main Congress activity will, of course, be the presentation of papers on recent scientific research in relation to the breeding and rearing of poultry and the production and marketing of poultry products. The social side, however, is not being forgotten and an attractive program of entertainment is being prepared, special provision being made for the entertainment of ladies accompanying members. Three extended tours are being arranged to take place before the Congress and afternoon tours and visits will take place during the period of the Congress. There will be an Exhibition which will show all aspects of poultry keeping in Scotland and will include education and research exhibits from agricultural colleges and research centres in Scotland and displays by manufacturers of feeding stuffs and appliances.

The International Festival of Music and Drama follows immediately after the Congress, giving members and delegates an opportunity of extending their stay in Edinburgh to include this world-famous event.

WHERE TO HOLD THE ELEVENTH WORLD'S POULTRY CONGRESS?

One of the outstanding responsibilities of the World's Poultry Science Association is the holding of a World's Poultry Congress every three years. At these Congresses poultry leaders of most countries throughout the world gather together to discuss problems of mutual interest concerned with the advancement of conditions in all branches of the poultry industry.

At each Congress programmes are presented giving the most up-to-date scientific information on production, disease control, marketing and allied subjects. These programmes have always been a great stimulus to poultry leaders and the

public not only in the countries in which the Congresses were held but to all other countries as well. Educational, livestock and commercial exhibits are staged by the host country and these have been particularly interesting to the thousands of producers and others attending each Congress. Commercial exhibits present the most recent inventions in the manufacture of equipment and supplies while the livestock exhibits display the popular and rare breeds of the host country.

Congresses in the past have been of immense benefit to the countries in which they have been held as well as to other countries. They have served to impress upon Government and other officials the importance of the poultry industry as a branch of agriculture and in the national economy. In addition these Congresses have been of tremendous international significance. They have served to bring together the peoples of different countries in a common purpose and on a common ground of friendliness and understanding.

Nine Congresses have been held. Holland, Spain, Canada, England, Italy, Germany, the United States, Denmark and France, in the order mentioned, have each held a Congress. The next, the 10th is being held in Scotland (Edinburgh) from 13th to 21 August, 1954. It would now seem appropriate to consider other countries.

Poultry leaders in countries anticipating holding the 11th World's Poultry Congress are invited to write the President of the World's Poultry Science Association, Monsieur Alex Wiltzer, 28 Rue Bonaparte, Paris 6eme. France, or The Secretary, Major Ian Macdougall, 45 Bedford Square, London, W.C. 1, England.

Normally, invitations are considered at the meeting of the Council of the Association held during the preceding Congress. Official invitations for the Eleventh Congress should be submitted in time for that meeting to be held in Edinburgh in August, 1954.

COUNTRIES THAT HAVE OFFICIALLY SUPPORTED OR PARTICIPATED IN ONE OR MORE WORLD'S POULTRY CONGRESSES

Argentina, Australia, Austria, Belgium, Bermuda, Brazil, British Guinea, British India, Bulgaria, Burma, Canada, Ceylon, Chile, China, Colombo, Cuba, Cyprus, Czechoslovakia, Denmark, Dominican Republic, Ecuador, Egypt, England, Estonia, Finland, France, Germany, Guatemala, Gold Coast, Holland, Hungary, India, Italy, Irish Free State, Japan, Latvia, Malaya, Malta, Mexico, Netherlands East Indies, New-

foundland, New Zealand, Northern Ireland, Nyasaland, Norway, Pakistan, Palestine, Persia, Peru, Poland, Portugal, Rumania, San Domingo, Scotland, Sierra Leone, Southern Rhodesia, Soviet Union, Spain, Sweden, Switzerland, Turkey, Union of South Africa, United States of America, Uruguay, Venezuela, Yugoslavia.

NURUL ISLAM, PAKISTAN'S POULTRY LEADER

It was a distinct pleasure to meet Mr. Nurul Islam the latter part of December because we have been carrying on correspondence for about a quarter of a century. Mr. Islam received his original training in poultry in the United Provinces of India and in 1927 conducted a survey of the U. P. poultry industry. He was a demonstrator and instructor at the U. P. Model Poultry Farm at Lucknow, India, and was a member of the Executive Committee of the U. P. Poultry Ass'n.

From 1928 to 1934 he was Officer-in-charge of the demonstration poultry car, giving demonstrations to farmers throughout the United Provinces and at the same time was Assistant Poultry Expert to the U. P. Government. From 1935 to 1944 he was Assistant Marketing Officer in charge of egg and poultry marketing for the Government of India. In subsequent years he held many important positions, including that of Poultry Expert to the Delhi Administration, India, member of the Poultry and Eggs Committee of the Imperial Council of Agricultural Research, and Editor of the Indian Poultry Gazette and Urdu Poultry Journal.

Practically since the establishment of the Dominion of Pakistan, Mr. Islam has been Poultry Expert to the Government of Pakistan, with headquarters at Karachi in West Pakistan. From 1948 to 1952 he has been Secretary-Treasurer of the All Pakistan Poultry Association and Editor of the Journal published by that Association. He is a member of the Publication Committee of the World's Poultry Science Journal for Pakistan, Iraq, Iran, and Arabia. He attended the Ninth World's Poultry Congress in Paris in 1951.

Mr. Islam is now spending about four months in the United States studying poultry husbandry practices with particular emphasis on our methods of carrying on extension work and practices followed in marketing eggs and poultry. He is also interested in the latest results of research on breeding and feeding poultry for more efficient feed conversion in producing eggs and chicken meat.—M. A. Jull.

ON FLEAS, BLOOD AND THE CONTROL OF LEUCOSIS

F. B. HUTT and R. K. COLE

Department of Poultry Husbandry, Cornell University, Ithaca, New York, U.S.A.

In a recent issue of this journal, Carr (1952) has introduced some concepts about leucosis so novel and startling that they can hardly be allowed to pass without comment. We venture to disagree with Dr. Carr on several points, to cite evidence for our differing views, and to hope that our comments will be considered as constructive criticism which may be helpful in further studies of this serious disease.

WHAT IS LEUCOSIS?

Most of the differences in viewpoints arise from the fact that, although he referred to leucosis, leucaemia, and sarcomas as comprising the avian leucosis complex, Dr. Carr was apparently really writing, for the most part, about the much-studied Rous sarcoma, to the knowledge of which he has made valuable contributions. We consider (1) that the Rous sarcoma is not a part of the leucosis complex, (2) that it occurs so infrequently in poultry flocks as to be no problem, and (3) that the extensive laboratory studies of this transmissible tumor have thus far shed no light whatever on the control of lymphomatosis, which, in turn, is probably the poultryman's most serious problem today.

While not all pathologists agree on the classification of avian neoplasms, a majority of those in North America who work with leucosis would probably accept that given by Jungherr (1952). It includes in the avian leucosis complex only lymphomatosis, erythroblastosis, granuloblastosis, and myelocytomatosis. In our experience, the last three of these are uncommon, and the condition that causes the extensive mortality in poultry flocks is primarily lymphomatosis (neural, visceral, or ocular).

A suggestion that the virus causing the Rous sarcoma might be related to that (or those) causing fowl paralysis was made by Greenwood and Carr (1951). It was based on the fact that a highly inbred line of Brown Leghorns proved to be resistant to the Rous sarcoma but susceptible to lymphomatosis. From this they concluded that the Rous-sarcoma virus could transform to one causing fowl paralysis and that:

> "the sarcoma-leukaemia-fowl paralysis array of viruses . . . should be considered together. In this work, for example, resistance to (artificial) infection with sarcoma virus has only been obtained

at the expense of a much increased death rate due to fowl paralysis. Similarly, a possible reduction in fowl paralysis would be of little value if the effective result were merely to change the death certificate to 'tumor'."

It isn't. Perhaps the easiest way to demonstrate that reduction of mortality from fowl paralysis is *not* accompanied by an increase in mortality from other tumors is to show some of the pertinent data pertaining to our three strains of White Leghorns, two of which are genetically highly resistant to leucosis and the other highly susceptible. Details of the development of these strains and of their performance have been given in earlier reports (Hutt and Cole, 1947, 1948, Hutt, 1949, 1951). The incidence of deaths from different types of leucosis and from other kinds of tumors in these lines is shown in Table 1 for the two latest populations that have completed their tests to 500 days of age.

TABLE I

Incidence of leucosis and of other tumors as primary cause of death between six weeks and 500 days of age in three lines of White Leghorns.

Year and strain	Females alive at six weeks, number	Deaths from leucosis, per cent				Deaths from other tumors, per cent
		Neural	Visceral	Ocular	Total	
1950-51						
K Resistant	990	0.2	0.5	0	0.7	0
C Resistant	750	1.2	1.2	0.1	2.5	1.3
Susceptible	624	19.1	4.3	0.5	23.9	2.7
1951-52						
K Resistant	698	1.7	0.9	0	2.6	0.1
C Resistant	1479	0.6	1.8	0.3	2.7	1.1
Susceptible	566	52.7	6.9	1.4	61.0	1.2

In this condensed summary, the few cases of erythro- and granuloblastosis that were found, also the myelocytomata, are included for convenience with the cases of visceral leucosis. As the figures for the Susceptible strain show, the exposure in 1950-51 was comparatively light, and deaths from leucosis in that year (23.9 per cent) were less than half as frequent as in the same strain in 1951-52 (61.0 per cent). The latter figure is more typical for that strain in recent years.

The important thing to note in relation to the present discussion is the complete absence of any inverse relationship between the incidence of leucosis and that of other tumors. The two genetically resistant strains, with total mortality from leucosis in different groups and years varying only from 0.7 to 2.7 per cent, showed even lower frequencies of other tumors, the incidence of which varied from 0 to 1.3 per cent. In 1950-51, when exposure to leucosis was comparatively

light and mortality from that disease in the Susceptible line was far below normal, the incidence of other tumors in that strain got up to 2.7 per cent.

It is obvious that a pullet that escapes death from paralysis prior to 6 months of age can subsequently succumb to an accident, to some other disease, or even to some other kind of tumor. However, the data in Table 1 show no evidence that fowls, whether genetically resistant or genetically susceptible to leucosis, are likely, if spared from death by that disease, to fall victims to some form of sarcoma. More direct evidence on this point was provided by Carson (1951) who found, when chicks were inoculated with a standard dose of the Rous sarcoma, either of its cells or its filterable agent, that our K line, highly resistant to leucosis, was also more resistant than our Susceptible line to the Rous tumor. Such dual resistance is not necessarily constant, for investigators at the Regional Poultry Laboratory (1950) in tests with six different lines could find "no correlation between resistance to inoculation with Rous sarcoma virus and resistance to lymphomatosis".

From these facts it seems probable that some interpretation other than that of Greenwood and Carr must be found for the occurrence of lymphomatosis in their inbred strain of Brown Leghorns resistant to the Rous sarcoma. The most logical conclusion would seem to be that they carry not only genes for resistance to the one condition, but also genes for susceptibility to the other. Similar associations within a single strain or race of genetic resistance to one disease and susceptibility to another are well known in mice and men.

TRANSMISSION OF LYMPHOMATOSIS

From this survey of the background we now return to Dr. Carr's recent paper in this journal. He considers that leucosis is transmitted from bird to bird only by injection of the virus into the tissues. Such injection he believes is done by blood-sucking parasites. If this were so, obviously the poultryman should concentrate his efforts on mites, ticks, fleas, etc.

In our opinion, while all this may apply to the Rous sarcoma, and possibley also to erythroblastosis, it has nothing to do with lymphomatosis, which is the poultryman's real problem. Attempts to incriminate blood-sucking parasites in the transmission of lymphomatosis have yielded inconsistent results with more failures than successes (for review, see Olson, 1940). Moreover, under the usual conditions of artificial brooding, the great majority of chicks in northern latitudes

are not exposed to mites, ticks, or fleas during their critical first few weeks when they are most susceptible to infection with leucosis. (Never having seen a tick or flea on a chicken, we find Dr. Carr's "flea-full of blood" difficult to visualize.) While an occasional chick gets its toe picked or suffers some other injury, it is difficult to see how many of them could have punctures of the skin through which the causative virus could enter. Yet our chicks not exposed to blood-sucking parasites may subsequently experience over 60 per cent mortality from leucosis (Table 1).

How then do they become infected? To this question a definite answer can hardly be given. One suspects that they may ingest the virus with their feed, or pick it up from the litter. We have evidence that they may get it from the air, through the respiratory tract. The fact is that they need no help from blood-sucking parasites to develop lymphomatosis. It is quite possible that such parasites may transmit sarcomata, but these tumors are comparatively uncommon.

Dr. Carr states that the virus causing leucosis is transmitted through the egg, but does not specify to what kind of neoplasm he is referring. We suspect that he is again discussing a transmissible sarcoma, presumably that of Rous. It would be of interest to know if he has any evidence that lymphomatosis is transmitted from dam to chick through the egg. At the Regional Poultry Laboratory evidence has finally been obtained that visceral lymphomatosis can be thus transmitted (Cottral *et al.*, 1949), but the fact that it took nearly a decade of concentrated research to get that evidence suggests that the influence of such transmission, if there be any at all, must be very slight indeed. In two years' tests with highly susceptible stock reared in isolation, no influence of any infection transmitted through the egg could be detected (Cole and Hutt, 1951).

DO PULLETS INFECT THEIR OFFSPRING?

After stating that tumors in young birds carry more virus per gram than tumors in older birds, and that at 1-1½ years the carrier hen produces practically no infective virus, Dr. Carr goes on to warn against hatching from pullets because he considers them more likely to put the virus in their eggs than older birds. In his birds the risk of leucosis was "working out at about 25 times greater when pullet eggs were used".

We rely on birds over two years old as our reservoir of infection,—and we breed from pullets. In this connection the

record for some of our old hens and pullets used for breeding in 1951 may be of interest (Table 2).

TABLE II

Mortality from neoplasms from 42 to 500 days of age in females hatched from old hens or from pullets in 1951.

	Daughters from:	Alive at 42 days, number	Deaths from neoplasms, per cent
I	Old hens X proven sires	459	2.6
II	Pullets X untested cockerels		
	Shift I (early)	270	6.3
	Shift II (mid season)	412	3.6
	Shift III (late)	338	3.8
	combined	1020	4.4

No cockerel tests were made in the K Resistant line in 1951 (the latest population with complete records), hence no K pullets were used that year. The data in Table 2 pertain only to our C Resistant line, but they are typical of our results in breeding from both old hens and pullets during the past 10 years.

It will be noted that the incidence of neoplasms (mostly lymphomatosis) in daughters of pullets (4.4 per cent) is only 1.7 times its incidence in daughters of old hens. Let no one suppose that even this small difference is attributable to any greater infectivity of the eggs from pullet breeders. We usually get more leucosis from our cockerel-testing matings (where the pullets are used) than from our proven-sire matings, which contain old hens. Our records show that this occurs because some of the cockerels and pullets (all previously untested) do not transmit to their daughters as much genetic resistance as others.

To illustrate, the 1020 daughters of pullets considered in Table 2 represent 29 different sire-families. Among these 29 there were 8 in which no deaths whatever were caused by neoplasms, but there were 3 males that lost over 14 per cent of their daughters from that cause. Since these last must be included in the average for the pullet breeders, whereas only the very best sires get into the proven-sire matings, it is not surprising that the latter should regularly excel the cockerel-test flocks in viability. The difference is in the genes that the pullet eggs carry,—not in the viruses.

While thus presenting the case against Dr. Carr's theses, we should make it clear that we take no exception to his statements insofar as they are confined to the particular tumor with which he worked. He apparently considers that tumor as part

of the avian leucosis complex, and, hence, that his findings concerning it are applicable to lymphomatosis. We think not.

RESISTANT STRAINS

Dr. Carr dismisses the practicability of breeding resistant stock because of "several snags." One of these is that it will not be likely to eliminate the disease. We doubt if leucosis is likely to be eliminated for very long from any sizable area not isolated from other poultry flocks. In our opinion, leucosis is here to stay, and the most successful poultrymen will be those who learn how to control it. Ways of doing so by breeding, or by proper management, or both, were described earlier (Hutt *et al.*, 1944) and additional evidence of their value has recently been reported (Hutt and Cole, 1953).

Another snag is that "as one virus is eliminated, another one can take over." It is possible that, as Dr. Carr prophesies, a strain genetically resistant to leucosis may lose its value when some other virus "takes over." One can only say that it has not happened yet. In the light of present knowledge, there is doubt whether the various forms of the avian leucosis complex are caused by a single virus or by several. There should be little doubt about the desirability of breeding for resistance to it or to them.

We do not know what experience Dr. Carr has had in breeding fowls resistant to lymphomatosis, but from our experience in doing so during the last 18 years, we can say that the chief snag is a lot of unremitting hard work. It has been demonstrated not only that strains can be bred in which mortality from leucosis among severely-exposed fowls is negligible (see, for examples, Tables 1 and 2), but also that this can be accomplished concurrently with improvement in egg production, egg size, body size and other characters of economic value (Hutt and Cole, 1947, 1948). Strains bred for resistance in one locality have been proven to maintain that resistance when exposed in another 900 miles away (King, Cole *et al.*, 1952).

That the breeding of strains resistant to leucosis is not an academic pursuit but is a very practical procedure for any good poultry breeder has also been demonstrated by the consistent performance of several such strains among those entered in the New York Random Sample Test during its first two years of operation (King, 1951, 1952).

Finally, after thus emphasizing again the importance of genetic resistance to leucosis, it seems necessary to repeat what we have frequently said before, *i.e.*, for the poultryman

who is not a breeder, the best insurance against losses from the disease lies in good management. If he can get resistant stock so much the better, but, regardless of the stock, the chicks should be brooded in isolation from older birds during the critical first few weeks after hatching. In the United States it is probable that such protection should be given to more than 98 per cent of the chicks reared. Only the pedigree breeder can benefit from exposure of his chicks, since that reveals his resistant families. Other poultrymen gain nothing by taking such risks.

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INCUBATION PERIODS IN DAYS OF EGGS OF DOMESTIC BIRDS

Chicken, 21; turkey, 28; Muscovy duck, 33-35; other domestic ducks, 28; goose, 32-34; guinea, 28; pigeon, 17-19; peafowl, 28-30; Ring-neck pheasant, 23-25; Golden and Amherst pheasants, 25; Silver pheasant, 26-28; quail, 22-23.

SYMPOSIUM ON ANTIBIOTICS

The following papers were presented at a Conference of the United Kingdom Branch of the World's Poultry Science Association held in London, Nov. 21, 1952.

THE MODE OF ACTION OF ANTIBIOTICS

M. E. COATES

The National Institute for Research in Dairying, University of Reading, Reading, Berkshire, England

The growth promoting effect of antibiotics in animal diets first reported by Stokstad and Jukes in 1950 has now been amply confirmed by many workers, but so far, the mechanism by which antibiotics bring about an improvement in growth is by no means clear. Since some of the sulphonamides, arsenic acids and even detergents have also been shown to improve growth it has been assumed that all these substances produce their effect by destruction of micro-organisms which compete with higher animals for their means of livelihood. This assumption has recently been justified by the work of Reyniers and his colleagues of the University of Notre Dame, Indiana, who found that in "germ free" chicks growth was not improved by any of a range of antibiotics including penicillin, aureomycin, and streptomycin, whereas chicks kept in the conventional manner showed the usual improvement in growth when any one of the antibiotics tested was included in their diet. Because of technical difficulties, Reyniers' work has only been done on small groups of animals, but none the less his results show fairly conclusively that in the absence of micro-organisms antibiotics have no effect on growth.

The beneficial effect of antibiotics on animal growth could be the result of an alteration of the population of micro-organisms normally found in the gut or the suppression of an infection which prevents the animal growing at its optimal rate. The nutritional importance of the micro-organisms in the intestinal tract is not yet fully realized, but it is known that organisms present in the gut can synthesize certain vitamins and other essential nutrients, while others utilize food factors at the expense of the host. Alteration of the balance of the microbial population in the gut, such as might be expected on feeding any antibacterial substance, could therefore profoundly affect both the type and quantity of nutrients

available to the animal. Although assays have shown that penicillin given by mouth survives as far as the lower intestine, bacterial examination has revealed no consistent changes in the type or number of organisms present in the alimentary tract. Nevertheless, nutritional experiments have indicated that the chick's requirements of certain vitamins of the B complex are reduced when antibiotics are included in the diet. In particular the unidentified vitamins of the animal protein factor appear to be spared, for it is on all-vegetable diets that the most spectacular improvements in growth on feeding antibiotics are observed. This is obviously of great importance to the farmer in America, where pig and poultry rations are very largely composed of vegetable ingredients, but is of less importance in this country where many compounded feeds contain fish meal or other proteins of animal origin. The improvements in hatchability on feeding antibiotics reported by some American workers may also be the result of a sparing effect on unidentified components of the animal protein factor, but similar results are unlikely on the British type of breeders' ration. None the less, even on British diets containing ample vitamins and animal protein we have found very marked improvements in growth on feeding antibiotics and there must therefore be some further action beyond the straightforward economy of vitamins.

The possibility of the existence of a growth-depressing infection was first presented to us when Cuthbertson and his colleagues of Glaxo Laboratories Ltd., failed to confirm our findings. Chicks in their laboratory, which had not previously housed poultry, did not respond to penicillin, and grew as well without it as our own birds given the antibiotic. Since our own laboratory had been in constant use for chicks for a number of years the experiment was repeated in a new building on our own premises, and better growth with no response to penicillin was also observed there. It appeared from these results that some growth-depressing condition existed in the old chick room which was absent from premises not previously used for poultry. The condition was shown to be transmissible, for unless they were given antibiotics, birds in the new rooms declined in weight when chicks from the old room were placed with them in the same cages. We have therefore suggested the existence of a hitherto undescribed "infection" which prevents chicks growing at their optimal rate and which can be counteracted by antibiotics.

The nature of the infection is still obscure. There are no

obvious signs other than a slight depression in weight. Mortality among our birds is less than 1% and careful examination has failed to reveal the presence of any known poultry disease or parasite. Fumigation and disinfection of the old rooms resulted in a temporary banishment of the condition, but in spite of a strict hygienic regime it has been impossible to eradicate it entirely. We are continuing the study of the nature of this "infection" in small isolation units, in which it is possible to keep chicks free from the "infection." In these units, we have been able to induce the "infection" by feeding whole-gut contents from "infected" birds, whereas similar gut contents from "uninfected" chicks did not transmit the infection. We are also considering the possibility that this condition is similar to the "tiered" brooder house well-known to commercial chick breeders.

Thus our knowledge so far leads us to suggest that the mode of action of antibiotics is twofold. (a) an indirect economy of vitamins of the animal protein factor and (b) suppression of a hitherto undescribed infection which prevents optimal growth. Hence no benefit may be expected from addition of antibiotics to adequate diets except in the presence of a growth-depressing condition such as we have described or, possibly, in frank disease. Perfectly healthy chicks, in environments free from infection, would be expected to respond to antibiotics only on all-vegetable rations, and hence the usefulness of feeding antibiotics in this country is likely to be limited.

RESULTS OF EXPERIMENTAL TRIALS WITH ANTIBIOTICS

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The "antibiotics" are, by definition, the chemical substances produced by micro-organisms which have a toxic effect on other micro-organisms—they are the weapons in a natural chemical warfare between competing groups of organisms. The use of these materials has revolutionized the treatment of many human and veterinary diseases. Because of their original high cost less investigation has been carried out with poultry than with other farm animals of greater individual value. The use of antibiotics for combating losses due to disease will be discussed later in the symposium.

I will consider now only the results obtained under controlled conditions at experimental stations, to determine the possible benefits in poultry husbandry to be obtained by the use of antibiotics as routine, low-level dietary supplements for normal, apparently healthy stock. These studies have been stimulated by the report of Stokstad and Jukes that the addition of aureomycin to their ration increased the growth rate of such chicks in the first four weeks of life.[16] Similar findings have been made over and over again both with aureomycin and with other antibiotics—bacitracin, procaine penicillin, terramycin, etc., showing increases in both rate of growth and feed conversion efficiency.[6,11] But of course, this finding of an increased body weight at 4 weeks of age is of no direct value to the practical man.

The poultry man selling either meat or eggs is concerned with his costs over the whole production period, in terms of the value of the final saleable product; and only feeding trials over the whole period and with practical rations can provide a basis for consideration of changes in husbandry methods.

By far the most important section of the British poultry industry is *the production of table eggs*—whether the product is measured in protein, calories and vitamins, or £.s.d., and the provision of feeding-stuffs is the major item in the cost of this production. Even a small saving here is, therefore, more important than larger proportional savings in the other sections of the industry. The first question to be asked is therefore:

"Are antibiotics of benefit for laying birds"? *No*, there seems to be no effect on egg production feed conversion, or "normal" mortality. This is the opinion of two "unusually reliable sources" as regards American experiments.[5,10] We have found the same in an experiment with British-type rations.[3] There have been one or two reports of trials in which a group of birds receiving antibiotics has given slightly higher production than a control group, but in view of the great variability even between groups of birds receiving the same treatment[7] together with similar findings of depression of production by antibiotics these may not be *proof* of any benefit from the antibiotics. Many more trials have remained unpublished but I think it is fair to assume that the manufacturers supplying the antibiotics for all this work would have objected powerfully to the "orthodox" opinion if they felt it to be unjustified.

For breeding birds, the antibiotics have again failed to increase fertility or hatchability when they have been added to good, or even border-line rations.[4,5,10,18] There is evidence, with a high level of dosage, for a transmission of antibiotic to the developing chick but this is not considered to be of any practical importance.[10]

Growing pullets may have their initial growth-rate increased by the feeding of antibiotics, but we have not observed any effect on the time at which laying begins or the feed required by the birds up to that age.[1,2] The mature body weight, and subsequent egg production and egg size were unaffected.[3] An American trial has given the same results.[13] This is, of course, in line with general British opinion that 'forcing' the growth of pullets confers no long-term benefit.[8]

The results of experimental trials have, therefore, given no support to the use of antibiotics at any stage in the life cycle of the table egg industry.

"Can antibiotics stimulate table-bird production?" Yes, for the trials reported in the literature birds receiving suitable antibiotics have, at 10-14 weeks of age, been on the average 4 per cent heavier than the corresponding controls.[1,2,9,11,14] This is, of course, a very much smaller difference, when expressed as a percentage of the control body weight, than has been obtained with experiments finishing at 3-6 weeks of age, but the same "falling-off" in effect is to be seen in all the experiments for which the results at more than one age have been reported.

In general relative gain in feed conversion efficiency (lbs. live weight gains/lbs. feed eaten) has been about one half of the corresponding advantage in weight gain. The advantage in live weight gain has ranged from 0 to 11 per cent, and in feed efficiency from 0 to 4 per cent.

In our own trial where at 12 weeks of age the 11 per cent figure for weight gain was obtained, the difference remained after the carcasses had been eviscerated and dressed for table.[4] We were unable to detect any difference in quality when cooked. However, a refined American system of broiler grading on the basis of breast angle and general finish has given a slightly lower average rating to birds that had received an antibiotic as compared with controls.[14]

Contrary to expectation, the increased mean weight has not been obtained mainly with the poorer birds so as to give a more uniform group.[4,9] In fact, as the range in treated and control groups has been found not to differ consistently, the

best potential growers in a group must be improved as much as the worst.

In the largest series of trials so far reported in the United States, the same order of growth stimulation was obtained with birds kept in batteries, and birds kept on litter, and there were occasional failures to obtain a growth-stimulation with both methods of housing.[11] These failures also occurred with all three of the antibiotics under test.

Most workers have concluded from their comparative trials over short periods that aureomycin, bacitracin, procaine penicillin and terramycin are equally active when fed at a level of 20 grams per ton of feed, and that the level of procaine penicillin can be reduced to 5, or even 2, grams per ton whereas the others are less active at these levels.[9,11,12] (On the other hand in order to maintain a given level of penicillin activity in a mixed feed after storage, and particularly after pelleting it may be necessary to allow for more than 50 per cent destruction).[17] No extra gains have been obtained in general, by the use of more than one of these antibiotics at a time. The other antibiotics on which tests have been reported have been less promising.

The first poultry supplements with antibiotic activity were crude "fermentation residues" which also contained vitamin B_{12}. It has now become economic to start with pure antibiotics for animal feeding. They can still be mixed with other materials to form a compound supplement but it is no longer necessary to pay for both antibiotic and vitamin B_{12} activity when only one is required.

Parallel trials with rations of varying composition have usually given maximal growth with antibiotics added to the ration which gave the fastest growth without antibiotic.[9] There is therefore no evidence that the use of antibiotics will improve the possibilities of using poor quality rations. The faster growing bird needs both additional protein and calories, and in approximately the same proportion as in traditional non-antibiotic rations.[14] The practical implication of any effect on vitamin requirement has still to be worked out, but it is unlikely to be of economic importance with the combinations of feedingstuffs available in this country.

Most of the growth-stimulus with antibiotics occurs in the first 6 weeks of life, and it has usually been found possible to remove them at this age without any adverse effect on the live weight at 12 weeks of age.[5] This would cut the quantity required to one third of that needed for feeding over the whole period.

Results with turkeys have paralleled those with chickens. The same antibiotics have been shown to give an early growth stimulation in both species. The relative gain with turkeys has again been less in full-term trials than in laboratory experiments lasting 6-8 weeks. In a typical trial poults receiving a supplement of 10 g. of procaine penicillin per ton of feed were 11% heavier than a control group at 8 weeks of age, but only 3% heavier at 24 weeks.[15] There was only a 1% gain in feed conversion efficiency over the whole of the trial. Results may be much more striking if there is mortality and checking of growth due to disease in the control groups.[19]

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PRACTICAL APPLICATION OF ANTIBIOTICS

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The discovery by Jukes in 1949 that there was a new growth factor in antibiotic fermentation products was followed by some spectacular claims on the other side of the Atlantic. From the photographs published and the claims made, it appeared that American farmers were able to make two birds grow where one grew before and to make them twice the size of any bird previously hatched. The work in this country has shown this to be an overstatement. Under certain conditions the use of antibiotic supplements has been shown to be of value in the field in this country provided they are given to suitable species and at a time when they are susceptible to their use.

From the results we have obtained, the wholesale use of antibiotics in livestock in general would not be justified. In young birds and in young pigs if these antibiotics are given early in life during their period of maximum growth, then good results will follow, provided the management and housing, particularly housing, are of the usual practical farm type. By this I mean that the buildings are not kept spotlessly clean (which is not unusual anyhow under present day labour conditions) and that as a result there is the normal build up of mixed bacteria. In other words, if we have normal farming conditions and young birds then we can expect to get results from those fed the antibiotics. These results will show not by enhanced growth, but rather by normal growth because, it seems, the antibiotics remove or overcome a growth depressant, rather than provide a growth stimulant. This is best seen when the birds are kept under specially clean conditions and those not being fed the antibiotic supplement are seen to be as large as those fed the antibiotic.

The turkey responds most readily and this may be because of its relative vulnerability to ill health during its early weeks of life, presumably bacterial invasion has something to do with this. Cockerels for the table are also benefited as are, of course, pigs which are outside our discussion today. We have found that the bulk of the response to antibiotic feed is in the early stages of growth, in round figures, from hatching up to about 6 or 7 weeks of age, or even perhaps slightly longer, but after that stage the response dwindles away and the control birds eventually overtake the experimental ones. Consequently, it would be that part of the poultry industry concerned in feeding birds for table use, which would benefit most from their use. We have found no beneficial results from the use of these antibiotics so far as bringing pullets to maturity or into earlier production, nor have we found the eggs to be any larger, nor is there any improvement in hatchability. We doubt whether there is sufficient carry over from the hen into the egg to have any effect at all on the chick.

What must be remembered always is the very great difference between the American type of ration and the type in common use in this country. In America the ration is predominantly an all vegetable one, that is, it has no fish or meat meal, whereas in this country, of course, an all vegetable protein ration is the exception rather than the rule, and Vitamin B_{12}, present in protein of animal origin, is present in sufficient quantities in the normal balanced ration in this

country. This means that the addition of antibiotic fermentation products, containing vitamin B_{12} to the American type of vegetable ration will produce more profound results than those we will obtain with our animal protein ration in this country.

We must not forget that antibiotics were first introduced as a means of controlling infectious disease, and that since their introduction our approach to disease, both human and animal, has been revolutionized. The fear has, therefore, grown in the minds of many, that the use of these antibiotics in feed stuffs might encourage the development of organisms resistant to their curative action, because, after all, the dosage in which these antibiotics is used is very much below the medicinal one, and theoretically would encourage the development of resistant strains of bacteria. We are assured by bacteriologists that this is not likely because the action of these antibiotics must be a local one in the gut on the germs there, and therefore we must realize that the bacterial population is being constantly expelled by normal bowel evacuation and are replaced by fresh ones, which must be just as susceptible as their predecessors. It is not as if we are dealing with a generalized infection or a localized infection such as an abscess where the organisms are encased, or for example as we get in tuberculosis infection of the lungs or elsewhere. The population we are dealing with is constantly on the move and consequently is never long enough in the body to produce resistance.

Secondly, should the organisms actually become resistant to whatever antibiotic is involved, the bacteriologists tell us that it would be a simple matter to attack these supposedly resistant organisms by switching to another antibiotic. For instance, if during the course of feeding a penicillin supplement ration an outbreak of disease, usually amenable to penicillin, should occur, then presumably medication with aureomycin would be effective in overcoming it. Similarly we could assume that the same would be true if the state of affairs were the other way about.

We have found no difficulty in mixing the antibiotics in the feed prepared in the form of a pre-mix of so many grams of antibiotic per pound of antibiotic supplement and no practical milling problems present themselves.

The birds show no hesitation in eating such supplemented feeds and in fact on some occasions one has had the impression that young turkeys, for instance, show a markedly im-

proved desire and appetite for food, so that it appears that there are no practical difficulties in the way of mixing these antibiotics and no difficulty in getting the birds or animals to eat the supplemented foods.

I have felt, however, on several occasions that the increased body weight and size of the bird has apparently increased the demands for certain of the accessory food factors. By this I mean the vitamins and trace elements and this, of course, is not to be wondered at. If the food has been prepared for a normal growth rate it may become borderline when that range is accelerated. On the other hand one must bear in mind the thought that the growth rate only *appears* to be accelerated and that under conditions of favourable hygiene and absence of disease, no difference is apparent between the two groups. It might, therefore, appear that the accelerated growth rate in less hygienic conditions either increases the body's demands for certain factors because of the bacterial infection, or that the antibiotics make these factors less available to birds because, for example, they may kill out bacteria essential for the manufacture of certain vitamins or for the proper digestion of certain constituents of the ration.

In spite of occasional increase, for example, in the appearance of bad feathering, the health of the birds fed the supplemented diet is good, in fact better than the controls, and consequently the mortality is reduced. It would appear from ad hoc investigations in the course of the major experiments that some of the more troublesome conditions, such as salmonellosis, appear to be controlled by the antibiotic supplement in the food.

As an example of the feeding of penicillin and aureomycin supplementation I can quote the accompanying figures:

We have used in our experimental work chiefly aureomycin and penicillin and in one in pigs, streptomycin was used. Generally speaking although in a percentage of cases the penicillin fed birds responded more rapidly, the feathering and the finish of those on aureomycin appeared to be superior, and generally it appears to be the antibiotic of choice so far as the farmer is concerned. By that I mean that when the question is posed to the farmer "Which of these two antibiotics supplements do you prefer?" the answer is more often "Aureomycin".

One worry of course, is this still undecided question of the stability of these antibiotics because however little they cost if they are not stable in the food and will not last the

Age	Group on Penicillin			Group on Aureomycin (Aurofac)			Group on Ordinary Ration		
	No. of birds	Weight lb. oz.	Average Weight oz.	No. of birds	Weight lb. oz.	Average Weight oz.	No. of birds	Weight lb. oz.	Average Weight oz.
1 day	60	7 3½	1.9	60	7 2	1.9	60	7 ½	1.9
14 days	59	18 15	5.0	59	17 5	4.7	59	16 2	4.3
21 days	59	27 3	7.4	59	23 9	6.3	59	22 6	6.0
28 days	59	45 10	12.3	59	38 9	10.4	59	36 5	9.9
44 days	59	92 3	24.9	59	88 8	24.0	59	86 11	23.5
56 days	58	152 4	42.0	57	146 1	41.0	57	142 8	40.0
	Mortality 1			Mortality 1			Mortality 1		

usual life expected of the food much of the cost will have been incurred for no result at all. However, this is a problem which I understand is being tackled by the manufacturers of the various antibiotics, and there is little doubt that a stabilized form of all of them will become available. The antibiotics are stable enough in meals and mashes, the trouble arises when pelleting is carried out. The heat and moisture involved appear to cause a drastic reduction in the antibiotic content of the food.

Another point that, of course, has considerable importance is what effect is likely to follow the cessation of feeding antibiotics. In flocks where we have suddenly stopped feeding the antibiotic the progress of the birds stood still for about 4 weeks until they gathered momentum again and went forward at the normal growth rate. If, on the other hand, the feeding is gradually tailed off this unfortunate upset seems to be avoided. I have seen the published results of other workers and apparently they do not always get this effect on the sudden stoppage.

Another problem has been whether or not there is any

lasting carry over of the antibiotic in the flesh of the birds consuming it, and I am assured from information I have received that it is impossible to detect antibiotics in the flesh of the birds so fed, and there does not appear to be any significant carry over in the egg so that there should be little danger so far as human consumers are concerned.

In my own experience I have seen good results from the medication of food in the case of salmonella infection in turkeys.

To sum up, it appears to me from the results I have obtained that antibiotics are of value in fattening stock only. It is of little benefit in pullets or laying stock, it has no effect on hatchability or egg production. In the early stages of growth the accessory food factors, such as vitamins and trace elements must be looked after. There does not appear to be any building up of resistance to the antibiotic, the stopping of the antibiotic in the feeding stuff must be done gradually and the question of stability and cost must be settled soon.

The question has been posed as to whether or not it is possible to change over from a feeding stuff containing one particular antibiotic to another containing a different antibiotic and whether this will result in harm to the birds or in no response to the antibiotic. This appears to be very unlikely and a mixture of antibiotics can be used without ill effect in feeding, the results obtained are equally good, although no better than when one antibiotic is used alone.

I think, finally, to depart from poultry for a moment, that the antibiotics will be largely a matter for flesh production in pigs and turkeys and that in pigs particularly, there seems to be an important place for these antibiotics if one considers the hygienic and bacterial infection hazards which most pigs have to face.

POULTRY BREEDING CENTER IN PORTUGAL

A White Leghorn breeding center is being established at Lisbon, Portugal, under the supervision of Professor Alfredo Neves e Castro of the Superior School of Veterinary Medicine. He has recently imported baby chicks of a high laying strain from the United States.—Morley A. Jull.

ARE YOU GETTING GOOD FEED EFFICIENCY?

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At least five important "musts" are required for profitable broiler production. They are: (1) complete feeds and good feeding practices; (2) rapid-growing broiler strains with satisfactory market characteristics; (3) good management practices throughout the entire period: (4) appropriate disease prevention and control measures; and (5) proper marketing practices. It is well known to all successful broiler growers that the best results cannot be obtained unless all five of these "musts" are carefully observed.

Of particular concern, with present feed costs constituting up to 70% of the total cost of producing broilers, is the matter of improved feed efficiency. If the feed required to produce a pound of broiler meat can be reduced by one-tenth of a pound, the cost of producing a 3-pound broiler is reduced by at least 1½c. This amounts to a saving in feed cost of $15 per 1000 broilers. It seems advisable, therefore, to consider some of the factors which may influence the feed efficiency in broiler flocks.

First of all, it is essential to have a well-balanced, complete broiler mash which is capable of supporting rapid growth. Rations which will not support rapid growth are much less efficient than complete rations. In general, rations which are high in fiber tend to be less efficient than those lower in fiber.

For efficient feed conversion, however, a good feed alone is not enough. A broiler strain which is capable of growing rapidly is also vital. In addition, the mortality in the flock must be kept to a minimum since the birds that die will have consumed an appreciable amount of feed, particularly if the mortality occurs during the latter stages of growth. Feed wastage also must be kept to a minimum by following good feed practices. In this regard, hoppers should be filled frequently but never more than half full. Finally, it is important to market the broilers at the proper time. If broilers are held beyond 11 or 12 weeks, the amount of feed required to produce a pound of gain during that period is decidedly greater than that required during earlier periods. Table I illustrates the feed requirements and growth rates of broilers. These data were obtained in studies conducted at the University of Mary-

land where the broilers were growing rapidly throughout the 12-week period. It can be seen that 5 pounds of feed were required to produce a pound of broiler meat during the 12th week, while only 3.56 pounds of feed were required during the 10th week. The broiler prices and feed costs should be considered in deciding just when your broilers should be marketed. If the growth rate is not as rapid as that shown in the table, one would expect poorer efficiency in general. Ordinarily, it is not profitable to hold broilers after they reach an average weight of three pounds for mixed sexes.

TABLE I

Growth and feed requirements of broiler chickens.

Age (wks.)	Average weights, mixed sexes (lbs.)	Lbs. of feed per pound of gain		Total feed consumed per broiler (lb.)
		Per week	Cumulative	
1	0.17	1.60	1.60	0.13
2	0.34	1.88	1.79	0.45
3	0.57	2.08	1.93	0.93
4	0.85	2.26	2.06	1.56
5	1.18	2.42	2.16	2.36
6	1.53	2.55	2.26	3.25
7	1.89	2.73	2.35	4.23
8	2.26	2.00	2.46	5.34
9	2.67	3.27	2.59	6.68
10	3.10	3.56	2.73	8.21
11	3.50	4.12	2.90	9.92
12	3.85	5.00	3.11	11.67

RESULTS OBTAINED AT UNIVERSITY OF MARYLAND SUBSTATION

It should be of interest to review the results which have been obtained in the first four broiler trials conducted at the University of Maryland Broiler Substation located at Salisbury. The four broiler rations used in these trials together with the results obtained are shown in Table 2. Although these results may not be as good as those obtained in certain other instances, I believe they are considerably better than the average results obtained by most broiler growers. From this table, it can be seen that the results were very consistent from trial to trial. The average weights at 10 weeks ranged from 2.97 to 3.11 pounds per broiler. The feed efficiency varied from 2.72 to 2.84, and the mortality ranged from 8.4 to 1.6.

The rations shown in Table 2 are not overly supplemented, but rather, are sound, practical-type broiler rations.

TABLE 2

Composition of broiler rations used in substation trials and results obtained.

Ingredients	Trial 1 Lbs./ton	Trial 2 Lbs./ton	Trial 3 Lbs./ton	Trial 4 Lbs./ton
Ground yellow corn	1083	1196	1204	1158
Pulverized heavy oats	100	—	—	—
Wheat flour middlings	—	—	—	100
Fish meal, menhaden	50	75	50	50
meat scrap, 55%	—	—	50	50
soybean oil meal, solv.	510	450	480	400
Corn gluten meal	100	100	50	50
Dehydrated alfalfa meal, 17%	50	40	40	40
Dried whey product	—	40	40	40
Dried corn distillers' solubles	—	—	—	50
Butyl fermentation solubles	30	20	20	—
Limestone	35	20	20	25
Dicalcium phosphate	28	—	—	—
Steamed bone meal	—	45	30	25
Salt, iodized	6	5	6	6
Manganese sulfate	0.5	0.5	0.5	0.5
Vitamin A feeding oil (4500 IU/gm.)	2.0	2.5	2.0	—
"D" activated animal sterols	1.0	1	1	—
A & D supplement, dry (4000 IU A and 750 ICU D/gm.)	—	—	—	2
Vitamin B_{12} supplement (Merck's APF No. 3)	0.8	—	—	—
Antibiotic feed supplement (10 gms. terramycin/lb.)	1	—	—	—
Vitamin B_{12} and antibiotic feed supplement (2 gms. procaine penicillin, 3 mgs. B_{12}/lb.)	—	1	1	1
Choline chloride, 25% mix	2	2	1	1
DL-methionine	—	—	1	—
Nitrophenide, 25% mix	2	2	2	2
Xanthophyll and vitamin E acetate mix	—	—	2	—
	Gms./ton	Gms./ton	Gms./ton	Gms./ton
Niacin	15	20	20	20
Calcium pantothenate	2	5	3	4
Riboflavin	—	3	2	3
Av. weight, 10 wks., lbs.	3.11	2.97	3.08	3.02
Lbs. feed per pound live wt.	2.72	2.73	2.84	2.82
Mortality, %	8.2	2.9	3.6	2.4

WHAT CAN WE EXPECT FROM OUR POULTRY BREEDERS?

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It is with considerable temerity that I attempt to comply with this request to predict the future trends in poultry breeding. To my knowledge, no one is clairvoyant and any predictions here or elsewhere are only guesses, or estimates based somewhat precariously on past experience. There is one advantage in prognostication. If predictions subsequently prove to be correct the author of such may point with pride to his foresight. If on the other hand the future proves the predictions wrong, the author of them need not fear since no one will remember what was said anyway.

There are many basic facts which need to be known before predictions can assume any degree of reliability. The search for these basic facts is the basis of most research programs both in agricultural experiment stations and in so-called "pure" scientific institutions.

Based upon some "straws in the wind" here are some predictions. In general I believe the poultry industry will be based upon two types of birds. One will be developed specifically for egg production, and the other will be developed specifically for meat production. Less and less emphasis will be placed upon breeds as such, and more and more upon specially developed strains. Such strains may have little or no resemblance to the combinations of genes we now refer to as breeds. The pattern for this trend is already well established.

300-EGG AVERAGE POSSIBLE

Let us consider egg production development first. Of one thing I believe we can be assured, and that is that there will be considerable change, and I believe improvement. We hear considerable mention of a so-called "physiological ceiling". This talk is based on the fact that certain strains are not improving even under continued selection. There are several possible genetic explanations of this situation without bringing in physiological ceilings. Personally I can see no reason why we cannot look forward to 300 egg hen-housed averages based on improved feeding, breeding, and management. It has been done with ducks and no evidence is available to show that it cannot be done with chickens. The main obstacles to such a

record lie in rate of lay and mortality or morbidity. Rate of lay may be improved rather rapidly whereas improvement in disease resistance and general vigor may be slow. At present one of the major problems of cross breeding in various forms is the rather consistent increase in mortality.

SYSTEMS OF BREEDING

We have also heard considerable discussion of systems of breeding such as closed flock (purebreeding?), inbreeding and hybridization, recurrent selection in its various forms, topcrossing, etc. There are some conclusions which seem justified. First, each system has certain mechanical or economic advantages and disadvantages. Secondly, at present no one method has proved itself genetically superior. Thirdly, we will probably have all of these systems of breeding with us for some time to come, as well as, perhaps some new methods as yet undeveloped. The eventual decision on this matter will revolve around the type of gene action involved and economic expediency.

The meager evidence to date points largely to the fact that superior individual performance depends upon the desirable combination of genes present, and not upon the system of breeding by which it was developed. For example we find superior and inferior individuals and groups among our purebreds, crosses, and our hybrids.

Some evidence is accumulating that desirable performance is determined mostly by so-called additive and dominant genes which can be theoretically fixed in a closed flock. If we assume this to be true, it would be possible to produce strains possessing all desirable genes. This would involve crossing to introduce new genes followed by selection. Such a procedure would be long and difficult. The same goal might be accomplished more rapidly by some form of selective crossing.

On the other hand if gene interactions are important contributors to superior performance, there is little or no hope of developing closed strains having the maximum in performance.

With little or no critical evidence available, it is not possible to predict the final outcome. Since there is some evidence for at least a large portion of the additive type of gene action, I would suggest that we not discard any of our present breeding systems, and especially the closed flock system, but continue to explore and test until the answer is found.

CAN WE HAVE BOTH MEAT AND EGGS?

The big question today with regard to meat poultry is whether or not it is possible to have high quality meat strains which also lay well. At present there is no critical evidence that this cannot be accomplished. The evidence most frequently cited is the fact that the present day egg strains are poor meat producers and the meat strains are notoriously poor egg producers. In the first place such evidence is debatable and in addition no breeder has adequately tested whether he could improve both qualities. A few breeders have started to develop so-called dual-purpose fowl but have been forced by economic necessity to shift their breeding emphasis either to eggs or to meat.

On the positive side of the ledger, some data collected here at Purdue from a population segregating widely for several meat characteristics as well as egg production, showed no antagonism, either genetic or environmental, between egg production and any of the meat type characteristics. No such antagonism was found in strains highly selected for one or the other type but not both. Whether such antagonism will develop under heavy selection for both qualities remains to be seen. Until such evidence is accumulated, however, it is necessary to conclude that no antagonism exists and that the development of high production meat strains is possible.

The development of such strains, however, will be time consuming because of the reduction of progress due to selection for many characteristics. The process probably will be speeded up by selective crossing. Even here the absence of antagonism between such things as growth rate and egg production will be important because it is going to be necessary to have rapid growth on both sides of the cross. It is probable, therefore, that what we formerly sought as a "dual-purpose" bird will become our meat chicken of the future.

FASTER GROWTH COMING

What is going to happen to growth rate? I don't believe we have touched the ceiling on growth rate. It should be possible to produce broilers having a three pound average at eight weeks of age. While this increase will be accompanied by some increase in adult weight such increase will not be excessive This is because the effect of adult weight on growth rate is greatest at older ages, and as we push the market age younger and younger, the less will be the effect of adult weight. Thus

it may be possible to hold down adult weight somewhat which will result in greater efficiency of egg production, while increasing early growth rate.

Another effect of this increase in early growth will be greater feed efficiency. For all practical purposes there does not seem to be any such thing as genetic feed efficiency. In studies here at Purdue, breed differences in feed efficiency after correction for gain, could be detected only with complicated statistical procedures. The biology of such differences is still not understood. In other words the chief factor in feed efficiency of an individual bird is growth rate. Group or flock comparisons of feed efficiency, so freqently made, are influenced primarily by rate of growth, mortality, and the care exercised by the operator, and are seldom valid. If you are after high feed efficiency, then select a strain which has rapid growth to the desired age and low mortality. Thus an increase in growth to three pounds at eight weeks of age, whether brought about by improved feeding, breeding, or management or a combination of these, will greatly increase feed efficiency and I believe we can look forward to results approaching two pounds of feed per pound of gain.

Furthermore, this increase in growth rate with a resulting earlier marketing age will greatly increase the efficiency of utilizaton of equipment, buildings, and manpower by being able to run more broods per year. This might well be the major influence in lowering the cost of producing a pound of chicken.

MARKET TRENDS

Recent trends to cut-up, packaged chicken have made it possible to pack a hatchet-breasted broiler in such a manner that it looks like a broad-breasted bronze turkey. Consequently we find reduced emphasis on broad-breasted body type for its sales appeal value. On the other hand, evidence is available showing that broad-breasted types of fowl have a higher dressing percentage as well as a higher percentage of edible meat.

SUMMARY

In summary, the present trend seems to be toward fewer and bigger breeders. This is not good for the industry since we need many breeders trying out many ideas and procedures. One way to counteract this trend is to concentrate on methods of *accurately* evaluating strains for various purposes with more educational discussions on methods of breeding, with freedom on the part of the breeder to try new ideas; and less

emphasis on a restricted breeding program with recognition of individual birds. Some progress along this line is also evident in recent changes in the National Poultry Improvement Plan.

I have faith and confidence in our poultry breeders, those producing meat strains and those working with egg strains, those producing purebreds and those producing hybrids.

PHILIPPINES GOVERNMENT OFFICIALS STUDY U.S. METHODS

During the last four months of 1952 and January, 1953, two of the leading government officials of the Philippines visited several states studying various extension programs with a view toward applying them for the improvement of the poultry industry of their country.

Dr. Alfonso del Mundo Lecaros was particularly interested in various procedures involved in carrying on effective extension work among farmers engaged in poultry and other livestock production. He was also interested in learning how 4-H Club projects are carried on in the United States. Dr. Joes Abalos Cayabyab was interested principally in problems of nutrition, especially from the standpoint of determining the suitability of available feeds in the Philippines for broiler and egg production.—Morley A. Jull, University of Maryland.

LEBANESE POULTRY STUDENT IN U.S.A.

Mohamed Jamil El-Hassany, Beirut, Lebanon is spending one year in the United States studying poultry husbandry problems and extension methods. Between two semesters at the University of Maryland studying poultry production problems, Mr. Hassany will spend most of the summer at the Oklahoma Agricultural College studying poultry extension methods. At present, Associate Professor Hubert Lasater, Oklahoma Extension Poultryman, is in Lebanon serving in an advisory capacity with respect to the future development of the Lebanese poultry industry.—Morley A. Jull.

REVIEW OF POULTRY PUBLICATIONS

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GENETICS

BRETSCHER, A.
GENETISCH BEDINGTE UNTERSCHIEDE IN DER COLCHICIN-EMPFINDLICHKEIT BEI HÜHNERN. *Arch. Julius Klaus-Stift. 26:* 465-469. 1951.—In the creeper breeds of fowls the legs exhibit chondrodystrophy and the homozygous condition is lethal, so that a heterozygous creeper produces 25% lethal, 50% creepers and 25% with normal legs. By treating 4-day embryos with colchicine and measuring the legs 10 days later, the author finds the legs of "normal" segregates shortened, while those of normal Leghorns and other breeds are not affected. He, therefore, assumes a gene Sr in other breeds of fowls which is replaced by sr in Creepers and produces sensitiveness to colchicine. After considering 20 possible positions for this recessive gene he concludes that it probably occupies the corresponding locus in the homologous chromosome to the creeper gene or deficiency.—R. R. Gates. (Biological Abstracts)

CAREY, WILLIAM M., and GEORGE F. GODFREY. (Oklahoma A. and M. Coll., Stillwater.)
ERRORS IN PATERNITY RESULTING FROM THE DOUBLE SHIFT IN MALES. *Poultry Sci. 31:* 459-466. 1952.—The method of switching males in single-male pedigree pens was as follows. The 2d male was placed in the pen 5 days after the removal of the 1st male. During the period when the pen was lacking a male, all fertile eggs produced were credited to the first male. Eggs produced during the next 5 days were marketed. Beginning on the 6th day after the 2d male was placed in the pen, fertile eggs were credited to him. In 3 trials using Dominant White Rock or Silver Oklabar males mated on New Hampshire females, errors in paternity were found in all trials. In 8 out of the total of 15 pens in which errors were found, they ranged from 1.6 to 29.6% of all chicks produced during the first 11 days after it was assumed that the switch of males was completed. The no. of females in the pen did not influence errors in paternity. Artificial insemination did not reduce errors. Individuality of the male, preferential mating, and sperm competition caused errors in paternity. An extension of the period by 4 days that the replacing male is in the pen before crediting chicks to him would reduce the error in the high-error pens to approx. 3% for a 5-wk. period—*G. F. Godfrey.* (Biological Abstracts)

HAYS, F. A. (U. Massachusetts, Amherst.)
ARE THREE-HUNDRED-EGG HENS SUPERIOR BREEDERS? *Poultry Sci. 31:* 535-537. 1952.—The breeding records and daughters' performance were recorded on 59 out of a total of 68 300-egg hens. Likewise, breeding records and daughters' performance were available on 225 full sisters of 300-egg hens. In fertility and hatchability, the 300-egg birds were superior to their full sisters only during their first laying year. In the 2d, 3d and 4th laying yrs., the 300-egg hens were

inferior to their full sisters both in fertility and hatchability. Viability in daughters produced in the 1st laying year was higher for 300-egg hens than for their full sisters. After the 1st laying year daughters from 300-egg hens did not demonstrate superior viability. These data show that in annual egg production the daughters of 300-egg hens are superior to the daughters of their full sisters that laid fewer than 300 eggs. This finding agrees with a previous observation by Hays (1946) to the effect that the daughters of 300-egg hens were superior to the daughters of other hens in the flock that laid fewer than 300 eggs. This last observation had been made by Hall (1935): with White Leghorns. During the 3d and 4th laying yrs. the daughters of 300 egg hens and the daughters of their full sisters that laid fewer than 300 eggs averaged to lay about the same number of eggs. This last result may be due to the fact that all available 300-egg hens were used as breeders in their 3d and 4th laying yrs. while their full sisters were only retained if they had demonstrated superior breeding ability. The data, in general, furnish no evidence of over-dominance in 300-egg hens, but there is some evidence that very heavy egg production may impair reproductive ability after the 1st laying yr. In general, the data furnish some evidence that 300-egg hens are likely to be superior to their full sisters as breeders in raising the production level of the flock.—*Author.* (Biological Abstracts)

HAYS, F. A. (Massachusetts Agric. Expt. Sta., Amherst.)
EVALUATING SIRES ON THE BASIS OF THEIR DAUGHTERS' INTENSITY OF LAYING. *Poultry Sci. 31:* 287-290. 1952.—Five generations of Rhode Island Red pullets hatched from 1942 to 1946 were examined. These stocks came from a closed flock, and records are available on 1284 pullets from 56 sires mated to 201 dams, all bred for high fecundity. In general, the data indicate that as a tool for reserving the best 25% of breeding males in any one year neither high Nov. intensity nor high Aug. intensity in daughters is very reliable. If, however, males are reserved, provided their daughters are highly intense either in Nov. or in the following Aug., the accuracy of selection is 80%. Such a plan of procedure would require the trapnesting of all daughters in Nov. at the beginning of the year and again in Aug. near the close of the year. There would be a reduction in the amt. of trapnesting required, but the time of selection would be the same as for complete progeny testing at the close of the first laying year of the daughters. When consideration is given to the selection of the best 11 sires tested during a 5-yr. period, the value of the system increases. The data indicate that when both Nov. and Aug. records are available, selection based either on the ability of the daughters to lay at a high rate during Nov. or during Aug., but not necessarily during both months, gave an accuracy of 95%. Despite the practical difficulties of such a method of selecting sires for future use, it does appear to have some merit.—*F. A. Hays.* (Biological Abstracts)

HUTT, F. B., and R. K. COLE. (New York State Coll. Agric., Cornell U., Ithaca.)
HETEROSIS IN AN INTER-STRAIN CROSS OF WHITE LEGHORNS. *Poultry Sci. 31:* 365-374. 1952.—Two improved strains of White Leghorns which had been maintained without interbreeding for 13 yrs. were crossed in reciprocal diallel crosses such that each sire was mated concurrently with females of his own strain and of the other. In 2 yrs., 9 sires were used, and 1074 daughters—approx. half being hybrids and half purebreds—completed the test to 500 days of age. Hatchability of the hybrids was about 5% higher than for purebreds. The hybrids, in comparison with their purebred half-sisters, began to lay about 5 days earlier. They laid more eggs (24 and 26 more in the 2 yrs.) and bigger ones (by 2.3 g.). The hybrids weighed at maturity 101 g. more in 1 yr. and 138 g. in the other. With respect to all these manifestations of heterosis, the 9 sire-families were remarkably consistent. Coeffs. of inbreeding in representative samples showed only about 0.13 for one strain and 0.08 for the other. The degree of heterosis observed in these crosses is compared with those in crosses of highly inbred lines, and it is suggested that enough heterosis may be attainable by crossing strains

not much inbred to make unnecessary the development of highly inbred strains for crossing, with all the attendant risks and losses. No consistent evidence was found that heterosis increases the viability of hybrids. —*F. B. Hutt.* (Biological Abstracts)

JAPP, R. GEORGE. (Ohio State U., Columbus.)
NEW THEORIES ON METHODS OF SELECTION AND MATING IN POULTRY. *World's Poultry Sci. Jour. 8:* 114-127. 1952.—Importance of gene frequency in a flock is emphasized. In the selection of parents, the units of measure, their economic value, and the differentiation between heredity and environmental effects are important. Genetic correlations and selection indices should become increasingly useful. Selection of high-above-average individuals in flock matings of closed flocks is best for highly heritable characteristics. Hybrid vigor causes small but probably worthwhile improvements. Closed flocks of widely dissimilar breeds with a history of successful crossing make good starting material. They should be tested by samples, and by families as crossbreds. Reciprocal recurrent selection, recurrent selection to an inbred tester, and crossing of highly inbred lines are methods of developing strains for cross-breeding.—*J. B. Christiansen.* (Biological Abstracts)

JEROME, F. N., and J. R. CAVERS. (Ontario Agric. Coll., Guelph, Can.)
CROSSES INVOLVING DOMINANT AND RECESSIVE WHITE IN COMBINATION WITH COLORS AND PATTERNS. *Poultry Sci. 31:* 427-433. 1952.—A simultaneous progeny test against a gold breed for a number of plumage genes in recessive white (cc) birds was devised, and the presence or absence of dominant white (I), extended black (E) and restricted black (e) in the genotype of the recessive white parent detd. Gold (s) or silver (S) can be identified at the same time provided neither dominant white nor extended black is present in the progeny. In progeny from New Hampshires males x White Rock females gold and silver in chick down were discernible under a single gene for dominant white with gene (E) absent. Sexing on a gold and silver basis was fairly accurate in chicks heterozygous for dominant white. From the females of one strain of White Rocks, mated to New Hampshire males, all the progeny carried the "wild type" striping which was, for the most part, more definite in the pullet chicks. Smokiness in down was not necessarily a down expression of gene E in recessive white birds. Two strains of White Rocks and one strain of White Cornish were analyzed. Birds with the genotype II EE cc produced the whitest chicks in reciprocal crosses with gold birds.—*F. N. Jerome.* (Biological Abstracts)

OSBORNE, ROBERT.
SEXUAL MATURITY IN BROWN LEGHORNS. THE INTERACTIONS OF GENOTYPE AND ENVIRONMENT. *Proc. Roy. Soc. Edinburgh 64 B.* 445-455. 1952.—In each of 3 years studied, the spring hatching period for a flock of Brown Leghorns at the Poultry Research Centre, Edinburgh, was divided into 2 sub-periods such that a number of matings are represented by offspring in each sub-period. Analysis of variance of age at sexual maturity reveals statistical interaction between family means and hatching period, the ranking of family means varying with date of hatch. Consequences of this are discussed with reference to current methods of correcting age at maturity for date of hatch, the method of multiple shift progeny testing, and the general question of improvement by selection in the presence of non-additive combinations of genentic and environmental effects. Measurements of comb growth in maturing pullets reveal a seasonal retardation, possibly reflecting retardation in sexual maturity, and in line with environmental effects causing cessation of production in older birds. It is suggested that rapid changes in day length during September and October may play a large part in determining the retardations and interactions displayed and that, where these changes cannot be eliminated, measurements of comb growth may be of value in recognizing consistently superior genotypes for age at sexual maturity.—*Robert Osborne.* (Biological Abstracts)

SKALLER, F., and G. W. GRIGG.
THE INHERITANCE OF SHANK COLOUR IN SINGLE-COMB WHITE LEGHORN AND AUSTRALORP FOWLS. *Australian Jour. Agric. Res. 2: 494-497. 1951.*—A genetical formula, including 4 autosomal and 2 sex-linked genes, is suggested which would explain the mode of inheritance of shank color in White Leghorns and Australorps. The observations consist of 847 single crosses, 71 backcrosses, and 31 zig-zag crosses.—*Auth summ.* (Biological Abstracts)

PHYSIOLOGY

BLYTH, J. S. S. (Poultry Res. Centre, Edinburgh.)
THE CORRELATION BETWEEN EGG NUMBER AND EGG WEIGHT IN THE FOWL: AN INVESTIGATION OF ITS INCONSISTENCY. *Poultry Sci. 31:* 254-268. 1952.—The relation between egg number and egg weight was examined for March for two 5-yr. periods. Among birds which laid 22 eggs or more, a negative, significant and apparent linear correlation was found. In groups of poorer producers, this association does not hold. Body wt. was positively correlated with egg wt. but its association with egg number seemed to be mainly through the latter.—*H. Branion.* (Biological Abstracts)

BRANDT, L. WARREN, HERMAN D. SMITH, A. C. ANDREWS, and ROBERT E. CLEGG. (Kansas State Coll., Manhattan.)
ELECTROPHORETIC INVESTIGATION OF THE SERUM PROTEINS OF CERTAIN BIRDS AND THEIR HYBRIDS. *Arch. Biochem. and Biophys. 36:* 11-17. 1952.—Electrophoretic comparisons of the blood sera from certain gallinaceous birds and their hybrids have showed that, in the case of the hybrid of the chicken and the ring-necked pheasant, two closely related, fast-moving peaks were present. These peaks were related to components in the patterns of the parent birds. Other components present in the hybrid serums were electrophoretically identical with components found in 1 or both hybrids. Greater differences were shown in the case of the chicken hybrid and the ring-necked pheasant than in the case of pheasant hybrids.—*R. E. Clegg.* (Biological Abstracts)

DRAPER, CARROLL I., JOSEPH R. HARRIS, DELBERT A. GREENWOOD, CLYDE BIDDULPH, LORIN E. HARRIS, FERRON MANGELSON, WAYNE BINNS, and MERTHYR L. MINER. (Utah State Agric. Coll., Logan.)
THE TRANSFER OF DDT FROM THE FEED TO EGGS AND BODY TISSUES OF WHITE LEGHORN HENS. *Poult. Sci. 31:* 388-393. 1952.—Laying hens were fed mashes containing 15% of alfalfa meal. The alfalfa used in making the meal was dusted with 0,1,2, and 4 lbs. of DDT per acre. Technical DDT was also added to mashes at levels of 0,50,100 and 200 ppm. The avg. DDT content of the eggs was 2.5, 2.8 and 6.4 ppm. when the hay was dusted with 1, 2, and 4 lbs. of DDT per acre, respectively. The fat tissues contained 52, 59, and 110 ppm., respectively, for these treatments. When 50, 100, and 200 ppm. was added to the mash the DDT content of the eggs was 18, 34, and 46 ppm., respectively. The DDT content of the fat was 340, 356, and 2148 ppm. for the above treatments. The addition of alfalfa meal made from DDT-dusted alfalfa did not influence rate of mortality, egg production, or feed conversion. Direct addition of technical DDT tended to lower egg production.—*C. I. Draper.* (Biological Astracts)

ERIKSSON, STURE. (Inst. Animal Nut., Royal Agric. Coll. Sweden, Uppsala.)
THE INFLUENCE OF SHELL POROSITY ON HATCHABILITY OF HEN'S EGGS AND THE EFFECT OF CHOLINE ADDED TO A BALANCED CHICK RATION. *K. Lantbrukshögskolans Annaler 18:* 20-28. 1951.—In a hatch of 225 eggs of White Leghorn hens, it was

shown that the hatched eggs in % of fertile eggs decreased with increasing wt. loss of the eggs in the 24-hr. period before they were incubated. 0.2% choline chloride added to a normal chick ration had no positive effect.—*Auth. summ.* (Biological Abstracts)

GILBREATH, J. C. JR., and CHARLES W. UPP. (Louisiana State U., Baton Rouge.)
THE GROWTH PATTERN OF THE CORNISH FOWL. *Poultry Sci. 31:* 418-427. 1952.—Body wt., shank (tarsometatarsus) length, keel (sternum) length, anterior body depth and breast width score were used as criteria in studying the growth pattern of 384 dark Cornish chickens of both sexes for the first 28 weeks after hatching. During the 1st phase, of 12 weeks, weekly measures were taken of wt., shank length and body depth and at the 4th, 8th and 12th weeks keel length and breast score were also recorded. Random samples of 100 males and 100 females were selected at 12 weeks of age and were measured at 4-week intervals through the 28th week. Means, standard deviations and coeffs. of variability are presented by sexes in tabular form with the means also presented graphically. The variance within both sexes for wt. and for length of tarsometatarsus was greatest at the 3d week of age. A significant sex difference was found in length of shank in newly hatched chicks and for wt., in chicks one week old. A true difference between the sexes first existed for body depth at 3 weeks of age, whereas for length of sternum no difference was found at 4 weeks of age although the difference was highly significant at 8 weeks of age. The differences between the sexes persisted for all criteria after they were first noted.—*C. W. Upp.* (Biological Abstracts)

HERRICK, E. H., and KEITH BROWN. (Kansas State Coll., Manhattan.)
LOWERED TENSILE STRENGTH AND COLLAGEN LEVELS IN TISSUES FOLLOWING DISCONTINUATION OF MALE SEX HORMONE. *Poultry Sci. 31:* 191-193. 1952.—After old male birds were caponized or treated with diethylstilbestrol there was a marked drop in the amt. of collagen in the tissues. Capons given testosterone propionate developed increased strength and collagen levels, which decreased after discontinuation of the hormone treatment.—*Auth. summ.* (Biological Abstracts)

KLINE, IRENE T., and RALPH I. DORFMAN. (Western Reserve U. Sch. Med., Cleveland, Ohio.)
ESTROGEN STIMULATION OF THE OVIDUCT IN VITAMIN-DEFICIENT CHICKS. *Endocrinology 48:* 345-357. 1951.—The inanition which accompanies a state of vitamin deficiency is responsible for a nonspecific, reduced sensitivity of the oviduct to the action of estrogen. When this reduced sensitivity is taken into consideration it is found that estrogen exerts a greater than expected stimulation in thiamine-deficient pullets. In riboflavin-deficient pullets the reduced response to estrogen may be accounted for, superficially at least, on the basis of inanition alone but may be the algebraic sum of numerous factors such as reduced inactivation of estrogen and decreased functioning of the mechanisms for tissue proliferation. In nicotinic acid-deficient pullets low doses of estrogen can exert a greater than expected influence on oviduct growth but high doses are less effective than in inanition controls. A deficiency of pteroylglutamic acid (PGA), however, results in a severe limitation of response to estrogen at all dose levels. The implication is that PGA is essential to the mechanism of action of estrogen in promoting tissue proliferation in the chick oviduct at the level of the end organ itself. The naturally occurring estrogen, estrone, is similar to the synthetic stilbestrol in that it also does not effect an optimal stimulation of the oviduct in chicks deficient in PGA.—*Auth. summ.* (Biological Abstracts)

KOSIN, I. L., HANS ABPLANALP, JOSE GUTIERREZ, and J. S. CARVER. (State Coll. Washington, Pullman.)
THE INFLUENCE OF EGG SIZE ON SUBSEQUENT EARLY GROWTH OF THE CHICK. *Poultry Sci. 31:* 247-254. 1952.—A 3-yr. study was conducted involving some 1660 sexed chicks, designed to study the extent to which the hatching egg wt. influences the body wt. gain of

the chick hatching from it. The observations extended from 0 to 12 weeks of age. 8 breeds and crosses were used in the study. Results indicated that while egg size frequently exercises a measurable positive effect on body wt. gain, variations due to breed and sex differences precluded a generalization with respect to this relationship. When present, this relationship was most prominent in the early period of growth. Mean growth rate of chicks from large and from small eggs showed, on the whole, a slight advantage for the former.—*I. L. Kosin.* (Biological Abstracts)

KRITCHEVSKY, DAVID, and MARTHA R. KIRK. (U. California, Berkeley.)

RADIOACTIVE EGGS. II. DISTRIBUTION OF RADIOACTIVITY IN THE YOLKS. *Proc. Soc. Exptl. Biol. and Med. 18:* 200-202. 1951.—The radioactivity in the yolks of eggs laid by a hen fed Na acetate-1-C^{14}, appears in all fractions of all yolks in the following order of increasing specific activity: protein, glycerol, phospholipid, fatty acid, cholesterol. The peak activity is reached in the 6th and/or 7th yolks (of 7 eggs laid) for all components. The most convenient method for separation of non-saponifiable and fatty acid fractions was by use of the ion exchange resin Amberlite IRA-400, which adsorbs the fatty acids. The protein and phospholipid were separated by the usual means. Glycerol was obtained free or as the tribenzoate.—*David Kritchevsky.* (Biological Abstracts)

LERNER, I. MICHAEL. (U. California, Berkeley.)

NATURAL SELECTION AND EGG SIZE IN POULTRY. *Amer. Nat. 85:* 365-372. 1951.—Exptl. evidence is given for the operation of natural selection for egg size in populations of domestic fowl. As a rule the counter-force of artificial selection in commercial flocks maintains avg. eggs size above the optimum for reproduction.—*Auth. summ.* (Biological Abstracts)

LERNER, I. MICHAEL, and C. A. GUNNS. (U. California, Berkeley.)

EGG SIZE AND REPRODUCTIVE FITNESS. *Poultry Sci. 31:* 537-544. 1952.—The reproductive fitness of birds laying eggs of intermediate wt. is greater than that of birds characterized by smaller or larger egg wt. Under artificial selection for large egg size max. hatchability is obtained in eggs below the mean egg size characteristic for the time of setting. Hatchability may be related to the size of each individual egg, but is also the property of the bird's genotype for egg wt. —*I. M. Lerner.* (Biological Abstracts)

MEISTER, WALDEMAR. (Chicago Nat. Hist. Mus.)

CHANGES IN HISTOLOGICAL STRUCTURE OF THE LONG BONES OF BIRDS DURING THE MOLT. *Anat. Rec. 111:* 1-22 Illus. 1951.—The compacta of the long bones of birds undergoes a series of transformations during the molt. Enlargement of Haversian canals destroys parts of Haversian systems by erosion of the compacta. Cavities thus formed in some Haversian systems produce osteoporosis, which may be extensive. Cavities communicate with the marrow cavity and with the periosteum through the Volkmann's canals, which are relatively slightly enlarged. Destruction is followed by deposition of new bone to form a new Haversian system. Destruction and reconstruction may be observed in the same section. Changes are more pronounced nearest the marrow cavity, and an inner zone of affected bone is often clearly delimited from an outer relatively unaffected zone nearest the periosteum. Similar osteoporosis was observed in long bones of deer with antlers in velvet. Reticular cells, from which osteoblasts, osteoclasts, and osteocytes develop, accompany the blood vessels from the marrow into the Haversian canals, and the Haversian canals are functionally extensions of the marrow cavity. The fact that a mineral draft from the bones accompanies feather and egg-shell formation as well as antler formation in deer suggests that the entire mineral metabolism may pass through the bones under specific hormonal control.—*Auth.* (courtesy Wistar Bibl. Serv.)

NAKAJO, SEIICHI. (Miyazaki U., Japan.)
EFFECT OF ELECTRICAL STIMULATION OF THE HEAD ON BROODINESS OF CHICKENS. *Poultry Sci. 31:* 337-342. 1952.—Electrical stimulation of the head interrupted broodiness with 1-3 treatments on alternate days with an alternating current of 50 cycle, 30 volts. There was no difference between 3 types of stimulation; the 1st twice for 3 sec. with an interval of 7 sec. and repeated in an hr.; the 2d twice for 5 sec. with an interval of 15 sec.; the 3d twice for 8 sec. with an interval of 30 sec. The stimulation needed to interrupt broodiness was variable in the same individual but it bore no relationship to days of broodiness prior to stimulation. There was no seasonal differences in response nor any relationship between days of non-laying after broodiness and times of stimuation or days of broodiness.—*H. Branion.* (Biological Abstracts)

O'NEIL, J. B. (U. Saskatchewan, Saskatoon, Sask.)
NO EVIDENCE OF COMPENSATORY PRODUCTION FOLLOWING A SLUMP. *Poultry Sci. 31:* 510-513. 1952.—Data are presented which indicate that a depression in production due to improper feeding is not followed by a higher than avg. rate of lay when the cause is removed. The time required for the birds to return to normal production will depend upon the severity of treatment. Once recovered, these birds may be used for further trials. Also if one replicate pens suffers a slump because of mismanagement, it can, upon recovery, be considered an integral part of the test since its production will not be higher than normal.—*J. B. O'Neil.* (Biological Abstracts)

O'NEIL, J. B., and W. J. RAE. (U. Saskatchewan, Saskatoon, Sask.)
CHANGES IN SPECIFIC GRAVITY OF EGGS DURING THE LAYING YEAR. *Sci. Agric. [Ottawa] 32:* 185-189. 1952.—Specific gravity of the egg was used as a measure of per cent shell. Results based on observations from 6166 Barred Plymouth Rock eggs over a 2-yr. period (1948-50) indicate that there is a significant decline in specific gravity during the test period (mid-Sept. to the end of Aug.) as the production of each bird advances. As the season progresses, the specific gravity decreases at a significant rate.—*J. B. O'Neil.* (Biological Abstracts)

SHIRLEY, RAY L., J. CLYDE DRIGGERS, JOHN T. McCALL, and GEORGE K. DAVIS. (U. Florida, Gainesville)
EXCRETION OF P^{32} and Ca^{45} INTO THE VARIOUS ALIMENTARY SEGMENTS OF HENS. *Poultry Sci. 31:* 316-320. 1952.—Laying White Leghorn hens were anesthetized and the segments of the intestinal tract ligated at their terminals. Concurrent doses of P^{32} and Ca^{45} were administered intramusc. and after several intervals from 15 min. to 8 hrs., the hens were sacrificed and the contents of the isolated segments were analyzed to obtain the excretion rate of the isotopes. Only traces of P^{32} and Ca^{45} were excreted into the contents of the esophagus and crop, and approx. 0.05% of each isotope into the contents of the proventriculus, gizzard and large intestine. The duodenum, small intestine, ceca and cloaca contained approx. 0.4, 5.4, 0.8, and 1% of the administered P^{32} and 0.6, 0.7, 0.3 and 0.6% of the administered Ca^{45} respectively, as max. values. Evidence of reabsorption of the P^{32} and Ca^{45} by the 8-hr. period was found in some segments. The cloaca values probably represent urinary excretion.—*J. C. Driggers.* (Biological Abstracts)

STADELMAN, W. J. (State Coll. Washington, Pullman.)
THE USE OF THIOURACIL AND DIETHYLSTILBESTROL IN FINISHING TURKEYS FOR MARKET. *Poultry Sci. 31:* 310-315. 1952.—Six expts. using over 100 Broad Breasted Bronze turkeys were conducted. By using 24 mg. of diethylstilbestrol implanted at the base of the skull of each turkey and 0.2% thiouracil in the feed it was possible to finish turkeys at 17 or 21 weeks of age. The treatment period was 4 weeks. An attempt was made to improve finish of turkeys at 11 weeks of age. Treatments were too severe for the young birds, causing some mortality. Fleshing was improved but torn backs were numerous in the

young birds. This condition was largely eliminated in older birds by separating the sexes prior to treatment.—*W. J. Stadelman.* (Biological Abstracts)

THOMPSON, R. L. (Kiambu, Kenya Colony, British East Africa.)
INCUBATION AT HIGH ALTITUDES: THE EFFECT OF WIND, BAROMETRIC PRESSURE AND HUMIDITY ON FOETAL MORTALITY IN THE HEN'S EGG. *Poultry Sci. 31:* 497-509. 1952.—Most incubators give poor results at high altitudes when operated in accordance with established practice. A successful technic is explained. Evaporation of water from incubated eggs is shown to be dependent on speed of air-movement, barometric pressure, and absolute humidity. The mathematical relationship of these meteorological factors is discussed and a hygrometric equation for incubators is advanced. An hypothesis to account for late-peak mortality is advanced and a possible remedy is suggested.—*H. Branion.* (Biological Abstracts)

TUPPER, R., R. W. E. WATTS, and A. WORMALL. (Med. Coll. St. Bartholomew's Hosp., London.)
THE INCORPORATION OF Zn^{65} INTO AVIAN EGGS. *Biochem. Jour. 51:* ix. 1952.—No. Zn was found in the white or shell after Zn^{65} admn. to hens. The yolk Zn was present in the lipovitellin. (Biological Abstracts)

WEISS, H. S., and P. D. STURKIE. (Lab. Avian Physiol., Rutgers U., New Brunswick, New Jersey.)
TIME OF OVIPOSITION AS AFFECTED BY NEUROMIMETIC DRUGS. *Poultry Sci. 31:* 227-231. 1952.—One- and 2-yr. old laying White Leghorn hens were injd. with various drugs to determine their effects on time of laying. The drugs used were acetylcholine, ephedrine, atropine, yohimbine and histamine, and they were injd. when the egg was in the uterus. Acetylcholine and histamine produced premature laying of the egg, but acetylcholine was more effective. However, with the maximum dose (50-100 mg.) acetylcholine produced premature oviposition in only 62% of the cases. The minimum effective dose appears to be between 5 and 10 mg. 25-50 mg. of ephedrine sulfate, intramusc., to laying hens, produced retardation of laying of 4 hrs. or more in 45 to 73% of the birds. Multiples doses of 50 to 250 mg. may produce retardation in 100% of the birds. Some of the retarded eggs were abnormal in shape. None of the drugs affected time of ovulation.—*P. D. Sturkie.* (Biological Abstracts)

NUTRITION

BERG, LAWRENCE R., GORDON E. BEARSE, JAMES McGINNIS, and CECIL F. McCLARY. (Washington Agric. Expt. Sta., Pullman.)
VITAMIN B_{12} IN THE NUTRITION OF THE LAYING HEN. *Poultry Sci. 31:* 488-496. Illus. 1952.—New Hampshire pullets, half of which were raised on herring fishmeal rations and the other half on soybean oil meal rations, were used to study the effect of vitamin B_{12} on the requirement of protein by laying birds. Rations containing 15, 13 and 11% all-vegetable protein were compared with and without 3 μg. of added vitamin B_{12} per 100 g. of ration. Vitamin B_{12} enhanced the utilization of low protein rations by laying birds. Level of protein in the ration affected rate of lay, loss in body wt., and extent of feather picking. Birds raised on a soybean oil meal growing ration laid fewer eggs and their eggs hatched at a lower rate than those of birds raised on herring fishmeal rations. The difference in rate of hatchability decreased as the experiment progressed, indicating the presence of a factor in fishmeal, other than vitamin B_{12}, which is stored by the bird and necessary for egg production and hatchability. Wheat straw litter changed at weekly intervals provided sufficient vitamin B_{12} to maintain more than 70% hatchability of fertile eggs.—*G. E. Bearse.* (Biological Abstracts)

BURNS, C. H., W. W. CRAVENS, and P. H. PHILLIPS.
THE REQUIREMENTS OF BREEDING HENS FOR SODIUM CHLORIDE. *Poultry Sci. 31:* 302-306. 1952.—Body wt., egg production, and hatchability of Single Comb White Leghorn pullets maintained in batteries and fed a purified ration could be maintained at normal levels on a minimum of 0.19% NaCl. Decreasing the NaCl level resulted first in a decrease in egg production followed by a decrease in body wt., while at the lowest level of NaCl tested (0.035%) hatchability remained unaffected. Egg production of birds on diets low in Na and Cl decreased to 20% by 5 weeks, while for birds on diets low in Na alone, it fell to zero in 3 weeks. Diets low in Cl alone, on the other hand, had little effect: This is interpreted as a Cl:Na imbalance, where increasing levels of Cl require increasing levels of Na for optimum egg production.—*W. W. Cravens.* (Biological Abstracts)

CARRICK, C. W. (Purdue U., Lafayette, Ind.)
SOYBEAN OIL MEAL AND CORN IN POULTRY FEEDING. *Feedstuffs 24:* 32-36. 1952.—The efficiency of a protein supplement is related to its crude fiber content because chickens digest very little fiber. Soybean oil meal is a very favorable protein supplement for poultry. It is a good source of glycine, supplying adequate amts. for chicks when fed at a 15% level. Soybean meal is slightly deficient in the sulfur-bearing amino acids, cystine and methionine, but meets the requirements for all other essential amino acids when fed as a supplement to corn. A chick starting ration may contain at least 50% corn and 35 to 37% soybean oil meal. The addition of casein, blood fibrin, and an antibiotic and B_{12} supplement to a diet made up of corn, soybean oil meal, fish solubles, mineral and vitamin supplements produced some increase in rate of growth for chicks. Turkey poults also make good growth when fed a corn-soybean oil meal type ration.—*H. L. Wilcke.* (Biological Abstracts)

CHILDS, G. R., C. W. CARRICK, and S. M. HAUGE. (Purdue U. Agric. Expt. Sta., Lafayette, Ind.)
THE NIACIN REQUIREMENT OF YOUNG CHICKENS. *Poultry Sci. 31:* 551-558. 1952.—Barred Rock chicks, maintained in batteries with raised screen floors, were fed a purified diet containing minute amts. of niacin for one week. After the depletion period, the chicks were paired and placed on a corn-soybean meal type of basal diet supplemented with methionine, vitamins, minerals and antibiotics. U. S. No. 13 hybrid corn was used in all expts. because it is low in niacin. The corn and soybean meal were assayed microbiologically for niacin. The basal diet contained 1.8 to 2 mg. of niacin per 100 g. Increments of crystalline niacin or niacinamide were added to the various test diets. Niacin and niacinamide proved equally effective in promoting growth and preventing symptoms of a niacin deficiency. The niacin requirement for rapid growth was adequately met with a level of 2.8 mg. of niacin per 100 g. of feed. All trials were conducted for 6 or more weeks.—*C. W. Carrick.* (Biological Abstracts)

COONEY, W. T., and J. E. PARKER. (Oregon State Coll., Corvallis.)
WOOD SUGAR MOLASSES AS A FEEDSTUFF FOR LAYING HENS. *Poultry Sci. 31:* 343-350. Illus. 1952.—Molasses prepd. from Douglas-fir waste was incorporated separately and in combination with dry beet pulp in rations for Leghorn pullets. Two feeding trials, each of approx. 1 yrs. duration, were conducted. 7.5% wood sugar mol. brought about an increase in egg prod. of approx. 5% with no increase in feed req. per doz. eggs produced. 15% wood sugar mol. or 7.5% wood sugar mol. in combination with 7.5% dry beet pulp failed to sustain egg production on the same level as did the control ration. Feed req. per doz. eggs for the latter 2 rations were also excessive. Feed intake was invariably increased when wood sugar mol. was incorporated in the ration. There is some indications that livability was favorably influenced by the use of wood sugar mol. Hatchability was improved by feeding 7.5% wood sugar mol.; this was not true at the 15% level. Body wt. and egg yolk color were not materially affected by the rations fed.—*W. T. Conney.* (Biological Abstracts)

CRAVENS, W. W. (U. Wisconsin, Madison.)
NOT ALL FEEDS NEED ANTIBIOTICS. *Feed. Bag 28:* 50-53. 1952.—The antibiotics, aureomycin, terramycin, bacitracin and penicillin all produce good growth stimulation in young chicks and poults. They should be used in rations containing fish products as well as vegetable protein sources. The author does not recommend the use of antibiotics after 12 weeks of age for turkeys. While results are not conclusive, it is felt that antibiotics do not improve egg production or hatchability. Arsenicals (arsanilic acid, sodium arsanilate, and 3-nitro 4-hydroxy phenyl arsonic acid) appear to stimulate growth about the same as the antibiotics. Accumulation of arsenic in the tissues does not appear to be a serious problem, at least for arsanilic acid and Na arsanilate, for which figures have been presented. Surfactants stimulate growth, particularly in the later periods, but they seem to have no application in the feed industry at this time.—*H. L. Wilcke.* (Biological Abstracts)

FULLER, H. L., C. W. CARRICK, and S. M. HAUGE. (Purdue U. Agric. Expt. Sta., Lafayette, Ind.)
A COMPARISON OF VITAMIN B_{12}, FISH SOLUBLES AND WHEY IN THE GROWTH OF YOUNG CHICKS. *Poultry Sci. 31:* 473-478. 1952.—Barred Plymouth Rock chicks were fed a depletion ration consisting largely of corn and soybean oil meal for 2 weeks. The chicks were then paired and placed on rations containing vitamin B_{12}, condensed fish solubles, or dried whey or various combinations of these supplements. 3% fish solubles was as effective in promoting the growth of the chicks as crystalline vitamin B_{12} fed at 3 μg./100 g. of ration. 4% dried whey improved the growth rate over the negative control but was less effective than pure vitamin B_{12}. Combinations of fish solubles and dried whey were much more effective than dried whey alone and slightly more effective than fish solubles alone. Neither fish solubles nor dried whey improved the growth rate when added to a ration containing adequate B_{12}, but when all 3 were fed together the growth rate was improved slightly over that of B_{12} alone. In one trial the difference between whey and either fish solubles or B_{12} was minimized by addition of streptomycin to the basal ration.—*C. W. Carrick.* (Biological Abstracts)

HEYWANG, BURT W. (U. S. Dept. Agric., Glendale, Arizona.)
THE LEVEL OF VITAMIN A IN THE DIET OF LAYING AND BREEDING CHICKENS DURING HOT WEATHER. *Poultry Sci. 31:* 294-301. 1952.—Data were obtained with 7 groups of White Leghorns kept under normal air temps., during a period of 196 days following a depletion period of 84 days. During the last 140 days of the expt. when the avg. maximum air temp. was about 101°F., the levels of 3720, 4960, 6200, and 7440 I.U. of vitamin A per pound of diet were about equally adequate for egg production, hatchability, and maintenance of life. The level of 1240 I.U. of vitamin A per lb. of diet was inadequate for all 3 functions. The level of 2480 I.U. of vitamin A per pound of diet was adequate for hatchability, but inadequate for maximum egg production and maintenance of life. Maintenance of live wt. was similar on all 6 levels of vitamin A. The data indicate that laying and breeding chickens need a higher level of vitamin A in their diet during prolonged periods of hot weather than during cool or moderate weather because of their decreased diet consumption during hot weather.—*B. W. Heywang.* (Biological Abstracts)

JENSEN, LEO S., and JAMES McGINNIS. (State Coll. Washington, Pullman.)
A COMPARISON OF FEEDING PELLETED AND UNPELLETED DIETS CONTAINING DIFFERENT LEVELS OF ALFALFA TO LAYING HENS. *Poultry Sci. 31:* 307-310. 1952.—Five all-inclusive diets containing from 2.5 to 25% dehydrated alfalfa were fed to White Leghorn hens for a period of 24 weeks. All diets except the one containing 2.5% alfalfa were fed in both the pelleted and unpelleted forms. No significant differences in egg production or egg wt. were evident among the various treatments. All groups fed pellets made substantial gains in body wt. during the expt., and all groups fed mash, except the 2.5% alfalfa diet, lost wt. A progressive increase in feed consumption

occurred with hens fed the pelleted diets as the level of alfalfa increased. An increase in the intensity of the egg yolk color was noted with higher levels of alfalfa.—*L. S. Jenson.* (Biological Abstracts)

KOHLER, G. O. (Cerophyl Lab., Inc.), **and W. R. GRAHAM, JR.** (Quaker Oats Co., Chicago.)
THE SEASONAL RESPONSE OF CHICKS TO AN UNIDENTIFIED GROWTH FACTOR FOUND IN FORAGE JUICE. *Poultry Sci. 31:* 284-286. 1952.—Faster growing chicks were obtained from commercial hatcheries in Missouri during months when good range was available to the hens. These chicks showed reduced responses to forage juice concentrates. Slower growing chicks were obtained when good range was not available to the hens. Such chicks are more suitable for assay of the unidentified growth factor.—*G. O. Kohler.* (Biological Abstracts)

KRATZER, F. H. (U. California, Davis.)
VITAMIN B_{12} AND ANTIBIOTICS IN THE DIET OF TURKEY POULTS FROM HENS FED NO ANIMAL PROTEIN. *Poultry Sci. 31:* 519-523. 1952.—Turkey poults were hatched early in the season from breeder hens kept on wire and fed a ration containing no animal protein concentrates did not respond to vitamin B_{12} supplementation. Later in the season, after a number of eggs had been laid, poults from these hens grew more rapidly when supplemented with or injected with vitamin B_{12}. Antibiotics in addition to vitamin B_{12} produced greater growth than could be demonstrated with vitamin B_{12} alone.—F. H. Kratzer. (Biological Abstracts)

LEE, CLARENCE E., C. L. HENRY, and JOSEPH PRESTO. (Research Div., Beacon Milling Co. Inc., Cayuga, N. Y.)
THE FEEDING SPACE REQUIREMENTS OF LAYING BIRDS RECEIVING A MASH, GRAIN AND SUPPLEMENTARY PELLET RATION. *Poultry Sci. 31:* 290-293. 1952.—Existing standards of hopper space for feeding layers have been based on general observation and not upon properly controlled research. This report covers carefully organized research beginning in 1944 and continuing through 1950. 2192 birds were included in this investigation. Comparisons were made primarily between allotments of 24 and 48 feet of actual feeding space per 100 layers. The results indicated that maximum production, with a good laying strain, could not be obtained at the lower level and that at least 48 linear feet of feeding space is required, with hopper fed dry mash supplemented with hand fed grain and pellets. A typical difference between the 24- and 48-foot allotments amounted to an avg. of slightly more than 1 egg per bird per month, 11.63 eggs per bird in 10 months).—*C. E. Lee.* (Biological Abstracts)

LILLIE, ROBERT J., and H. R. BIRD. (U. S. Dept. Agric., Beltsville, Md.)
EFFECT OF ANTIBIOTIC SUPPLEMENTS UPON HATCHABILITY AND UPON GROWTH AND VIABILITY OF PROGENY. *Poultry Sci. 31:* 513-518. 1952.—In an expt. conducted in laying batteries, crystalline vitamin B_{12} greatly improved the hatchability of eggs laid by Rhode Island Red pullets bred 3 generations for high susceptibility to vitamin B_{12} deficiency. A vitamin B_{12}-aureomycin supplement was less effective than crystalline B_{12}. This material, by chick assay, showed antibiotic activity. In an expt. conducted in open-front houses, where a basal diet low in vitamin B_{12} activity was fed, even the birds fed the basal diet maintained high hatchability, probably because of synthesis of vitamin B_{12} in the litter, as a result of the unusually mild winter of 1949-1950. The presence of an antibiotic in the vitamin B_{12}-aureomycin supplement appeared to have no influence on hatchability. With respect to chick performance, the incorporation of a vitamin B_{12} supplement or a vitamin B_{12}-aureomycin supplement in the maternal diet proved valuable. The poorest growth response occurred on the chick basal diet, intermediate growth on the basal plus a vitamin B_{12} supplement, and greatest growth on the basal plus vitamin B_{12}-aureomycin supplement, irrespective of maternal diet. Growth of chicks from dams fed vitamin B_{12} or a vitamin B_{12}-aureomycin supplement was better on the chick basal diet

than that of those chicks from dams fed no supplement. Progeny of dams fed a vitamin B_{12}-aureomycin supplement showed no consistent advantage over progeny of dams fed vitamin B_{12} alone. Growth differences of chicks from the 3 maternal groups were eliminated when a vitamin B_{12} supplement or a vitamin B_{12}-aureomycin supplement was incorporated in the chick basal diet.—*R. J. Lillie.* (Biological Abstracts)

MARCH, B. E., E. ENGLISH, and JACOB BIELY. (U. British Columbia, Vancouver, Canada.)
THE EFFECT OF CARRIER ON THE RELATIVE UTILIZATION OF DIFFERENT FORMS OF VITAMIN A BY THE CHICK. *Arch. Biochem. and Biophys. 36:* 259-268. 1952.—Liver storage of vit. A following admn. of large oral doses was used as the basis for comparison. Admn. of vit. A in aqueous carrier resulted in better utilization of the natural ester and of the acetate than of the alcohol. Admn. of vit. A in cottonseed oil resulted in better utilization of the alcohol than of the natural ester form. The amt. of storage from the acetate in the oil carrier was higher than that from either the natural ester or the alcohol. Vit. A analyses were conducted on the intestinal wall at different intervals after the admn. of vit. A palmitate and vit. A alcohol in oil and aqueous carrier. The absorption curves on the intestinal contents were also made to determine the presence of unabsorbed vit. A. It was demonstrated that the lowered utilization of vit. A palmitate in oil carrier was not due to the destruction of vit. A but rather to interference of the oil with the absorption of the vit. through the intestinal musoca.—*Auh. summ.* (Biological Abstracts)

MENGE, H., G. F. COMBS, PENG-TUNG HSU, and MARY S. SHORB. (U. Maryland, College Park.)
UNIDENTIFIED GROWTH FACTORS REQUIRED BY CHICKS AND POULTS. I. STUDIES WITH CHICKS USING PURIFIED DIETS. *Poultry Sci. 31:* 237-247. 1952.—Evidence is presented which indicates that in the chicks fed purified diets containing alpha protein or wheat gluten two distinct unidentified factors are required for rapid growth. One factor is supplied by liver fraction "L," liver fraction Biopar "C," and dried brewer's yeast, the other by dried whey (or dried whey products). Chicks from pullets housed on wire and fed a ration devoid of animal protein supplements responded more definitely to the factor present in liver than progeny from pullets housed on litter and fed a complete breeder ration. Progeny of hens housed for 18 mos. under the former conditions responded more to this factor than did progeny of pullets similarly maintained for only 4 mos. Progeny of hens housed on litter and fed a complete breeder ration throughout 1 laying yr., responded to the factor present in whey but not to the factor present in the liver fractions or dried brewers' yeast.—*G. F. Combs.* (Biological Abstracts)

MULLER, W. (Swiss Sch. Poultry breeding, Zollikofen.)
DIE GIFTIGKEIT VON HEXAPRAPARATEN (HEXACHLORCYCLOHEXAN) BEIM GEFLÜGEL. [THE TOXICITY OF HEXACHLOROCYCLOHEXANE TO POULTRY.] *Geflügelhof 15:* 299. 1952.—A mash containing 2/3 potatoes with a strong "Hexa"-smell and a control mash containing 2/3 normal potatoes were fed to groups of 31-day-old Leghorn chicks. The "Hexa" potato mash had no toxic effect on the chicks and there was no significant difference in growth between the groups. Chicks refused mash containing more than 0.5% Hexaterr (which contains 20% technical hexachlorocyclohexane or 2.5% of the gamma isomer of hexachlorocyclohexane). A dose of 1 g. or more of Hexaterr had strong toxic effects after a few days, a dose of 0.5% or less had no toxic effects within 10 days.—*Paul Griminger.* (Biological Abstracts)

MULLER, W. (Swiss Sch. Poultry Breeding, Zollikofen.)
BERICHT ÜBER VERSUCHE MIT VITAMIN T (GOETSCH)-GLEICHZEITIG EIN BEITRAG ZUR KREUZUNGSFRAGE. [REPORT ON EXPERIMENTATION WITH VITAMIN T WITH A CONTRIBUTION TO THE QUESTIONS OF HYBRIDIZATION.] *Geflügel-*

hof 15: 99. 1952.—Supplementation of the ration of growing chickens with vit. T (which was found by Goetsch to decide whether termites develop into "soldiers" or "workers") had no significant effect on chick growth or feed utilization in a 10-week feeding trial. It did not affect the age at which the birds started to lay or the number of eggs laid up to the 256th day. In crosses between "Italians" and "Mechelners" the development of the baby chicks was more uniform than that of the purebreds. The mean wt. on the cross-breds, and probably their feed utilization, were intermediate between those of their parent breeds throughout the 10-week feeding period.—*P. Griminger.* (Biological Abstracts)

NABER, EDWARD C., ESMOND E. SNELL, and W. W. CRAVENS. (U. Wisconsin, Madison.)

THE EFFECT OF FOLIC ACID ON GLYCINE TOXICITY IN THE CHICK. *Arch. Biochem. and Biophys. 37:* 158-163. 1952.—Glycine (5%) added to a purified ration caused a severe depression in growth accompanied by characteristic nervous symptoms. Ten mg. of folacin/kg. of ration was effective in completely reversing the toxic effects of glycine. Vit. B_{12} was ineffective. Folacin detns. on the livers of chicks receiving glycine indicate an increased storage of the vit. The total creatinine content of blood, muscle, and liver is higher in folacin-deficient birds. The possible signficance of these results is discussed. (Biological Abstracts)

NOORTGAETE, C. H. van den.

LES PROBLEMES DE LA NUTRITION MODERNE DE LA VOLAILLE. [PROBLEMS OF MODERN NUTRITION OF POULTRY.] *Bull. Ecole Meunerie Belge 13:* 45-52. 1951. (Biological Abstracts)

O'DELL, B. L., M. D. BOSTON, J. E. SAVAGE, and A. G. HOGAN. (U. Missouri, Columbia.)

THE USE OF ISOLATED SOYBEAN PROTEIN IN SYNTHETIC DIETS FOR CHICKS. *Poultry Sci. 31:* 559-563. 1952.—An isolated soybean protein, Alpha Protein, manufactured by the Glidden Company, when leached with hot water to remove sulfite and supplemented with methionine and the known vitamins, supports as rapid growth of White Leghorn chicks as a mixture of casein, gelatin and methionine. The commercial product, Alpha Protein, contains about 1% sulfite (SO_3) and causes rapid destruction of thiamine when mixed in a diet which is allowed to stand at room temp. The presence of sulfite in a synthetic diet also accelerates the production of rancidity. Oxygen consumption studies by use of the Warburg apparatus showed that sulfite either in Alpha Protein or as pure Na sulfite accelerates the oxidation of methyl linoleate.—*B. L. O'Dell.* (Biological Abstracts)

PARTHASARATHY, D., and S. G. IYER. (Indian Vet. Res. Inst., Izatnagar.)

DRIED COW MANURE IN THE RATION OF GROWING CHICKS. *Indian Jour. Vet. Sci. and Animal Husbandry 21:* 107-112. 1951.—Chicks were fed cow manure first dried in the sun and then at 80°C. at 10% level with a basal ration devoid of animal proteins. Cow manure induced comb development but failed to stimulate growth.—*N. N. Dastur.* (Biological Abstracts)

ROSENBERG, M. M., and JAMES SEU. (U. Hawaii, Honolulu.)

SWEET POTATO ROOT MEAL VERSUS YELLOW CORN MEAL IN THE CHICK'S DIET. *World's Poultry Sci. Jour. 8:* 93-98. 1952.—Roots dried at 150°F. caused growth depression and reduced feeding efficiency at levels from 7.5%-45% displacing corn. Storage 10 days before drying ("curing") improved their value, as did cooking, but not to the equal of corn.—*J. B. Christiansen.* (Biological Abstracts)

SLINGER, S. J., W. F. PEPPER, D. C. HILL, and E. S. SNYDER. (Ontario Agric. Coll., Guelph, Canada.)

SUPPLEMENTS TO A SOYBEAN OIL MEAL-CEREAL GRAIN BROILER DIET "ADEQUUATE" IN VITAMIN B_{12}. *Poultry Sci. 31:* 193-201. 1952.—Significantly better wts. of New Hampshire chicks at

6 weeks of age resulted from the addition, to a soybean oil meal-cereal grain basal diet containing 10 μg. of vitamin B_{12} per pound, of additional vitamin B_{12}, Ca pantothenate, 4% dried buttermilk, and 2% fish meal and 4% dried buttermilk. When the basal diet contained 2% fish meal and 4% dried buttermilk additional vitamin B_{12} again gave a significant improvement in wt. Improvement in wt. was not accompanied by better feed efficiency. The same relative effectiveness of diets was observed at 10 weeks of age but the differences were not significant. Methionine did not replace the need for vitamin B_{12} in this expt. Dilution of the various diets for the period of 6-10 weeks with a high-corn mixture in order to raise the productive energy level from 930 to 990 calories/lb. and reduce the protein content from about 20-17% did not lower the wts. at 10 weeks and improved the finish.—*S. J. Slinger.* (Biological Abstracts)

WEST, J. W., C. W. CARRICK, S. M. HAUGE, and E. T. MERTZ. (Purdue U. Agric. Expt. Sta., Lafayette, Ind.)
THE TRYPTOPHAN REQUIREMENT OF YOUNG CHICKENS AS INFLUENCED BY NIACIN. *Poultry Science 31:* 479-487. 1952.—Barred Plymouth Rock chicks were fed a purified diet very deficient in niacin for a period of one week. The chicks were then paired according to body wt. and sex and placed on appropriate diets. Tryptophan was significantly less effective when the diet contained 2 mg. of niacin per 100 g., when compared to the 5 mg. level of niacin. The niacin requirement was adequately met when the diet contained 3 or more mg. of niacin per 100 g. Excessive niacin (7 mg. %) showed no significant sparing action on the tryptophan requirement, since it failed to compensate for a deficiency of tryptophan. The tryptophan requirement is approx. 0.2% of the diet, and both optical isomers are utilized by the chick. That perosis may occur due to a deficiency of niacin was confirmed; the perosis syndrome occurred when the diet contained adequate Mn, choline and biotin. No consistent relationship was established between the dietary level of niacin and liver storage of niacin. For a given dietary level of niacin, there appeared to be less liver storage when the tryptophan content of the ration was increased.—*C. W. Carrick.* (Biological Abstracts)

ANONYMOUS.
ANTIBIOTICS AND THE STOCKBREEDER. *Milling [Liverpool] 118:* 470, 473. 1952.—Poultry and turkey poults benefit from antibiotics in the ration and good results are also obtained with supplemented feed for piglets and calves. The amount of antibiotics required for chick rations is about 0.5 oz. per ton. There is undoubtedly a promising future for use of antibiotics on the farm, but it is too early to say if their widespread use would lead to the development of resistant strains of bacteria that would minimize their beneficial effect.—*T. R. Aitken.* (Biological Abstracts)

POULTRY PRODUCTS AND MARKETING

BERGQUIST, DWIGHT H. (Henningsen, Inc., Sedalia, Mo.), **and GEORGE F. STEWART.** (U. California, Davis.)
SURFACE FORMATION AND SHEAR AS FACTORS AFFECTING THE BEATING POWER OF EGG WHITE. *Food Technol. 6:* 262-264. 1952.—As a part of a study to determine the cause of the loss in functional properties of egg whites during spray drying, the authors made specific studies of the effect of shear force and surface formation. The effects of these 2 physical agents on the beating power of egg whites were studied, using an electric mixer and a Bull surface denaturation device. Both shear and surface formations adversely affected the beating rate of egg whites. The effect of shear was dominant to that of surface formation. The relationship of these results to the spray drying of egg whites is discussed. (Biological Abstracts)

BERGQUIST, DWIGHT H. (Henningsen, Inc., Sedalia, Mo.), **and GEORGE F. STEWART.** (U. California, Davis.)
ATOMIZATION AS A FACTOR AFFECTING QUALITY IN SPRAY-DRIED ALBUMEN. *Food Technol. 6:* 201-203. 1952.—The study was designed to investigate the effect of 3 atomizing systems on the beating power of egg albumen. Results of the trials indicated that egg white is readily damaged by atomization. The effect was pronounced even where the conditions of shear and rate of surface formation were minimized by special nozzle design. The damage was lowest in albumen from fresh eggs. Fermentation prior to atomization was without effect. (Biological Abstracts)

BROADBENT, MARDEN, and H. W. BEAN. (U. Illinois, Urbana.)
THE YIELD OF EDIBLE MEAT FROM TURKEYS, DUCKLINGS, AND DIFFERENT MARKET CLASSES OF CHICKENS. *Poultry Sci. 31:* 447-450. 1952.—The percentage of edible meat (lean, fat, skin, and giblets) were detd. for 5 market classes of grade A chickens and with 9-weeks-old white Pekin ducklings. Similar work had been done elsewhere with turkeys. These data are compiled into tables. The relative cost per pound of edible meat for each species is shown on a nomographic chart.—*H. W. Bean.* (Biological Abstracts)

BROWN, PAUL B., and H. W. BEAN. (U. Illinois, Urbana.)
THE YIELD OF EDIBLE MEAT FROM DIFFERENT MARKET CLASSES OF CHICKENS. *Poultry Sci. 31:* 232-234. 1952.—20 birds from each of 5 market classes and breeds of chickens (1) crossbred broilers (New Hampshire males x Barred Plymouth Rock females), (2) Rhode Island Red fryers, (3) White Leghorn light hens, (4) White Plymouth Rock medium heavy hens, and (5) Columbian light roaster males) were randomly selected from the Univ. of Illinois poultry flocks and slaughtered. The raw edible meat (skin, fat, and lean) was mechanically separated from the bones. The yield of meat is expressed as a percentage of the live wt., New York dressed wt., and the eviscerated wt. An alignment chart shows the relative cost at varying prices of the edible meat obtained from each of these market classes of poultry.—*H. W. Bean.* (Biological Abstracts)

EVANS, ROBERT JOHN, HELEN A. BUTTS, and J. A. DAVIDSON. (Michigan State Coll., East Lansing.)
THE RIBOFLAVIN CONTENT OF FRESH AND STORED SHELL EGGS. *Poultry Sci. 31:* 269-273. 1952.—Eggs were obtained from 8 hens that were kept in laying cages and fed a diet of constant composition. Three eggs from each hen were used for each riboflavin assay. Eggs were assayed fresh and after 3, 6, and 12 months of storage at 0°C. Fresh eggs contained on the avg. 169.7 μg. of riboflavin per egg (3.49 μg. per g.) of which 100.6 μg. were in the white (3.14 μg. per g.) and 69.1 μg. were in the yolk (4.15 μg. per g.). During the first 6 months of storage, 14.1% of the riboflavin was lost. No further loss occurred during the next 6 months, but there was a transfer of riboflavin from the yolk to the white. Twelve-month-old eggs contained 147.0 μg. of riboflavin per egg (3.07 μg./g.) of which 92.7 μg. were in the white (3.33 μg./g.) and 54.3 μg. were in the yolk (2.72 μg./g.)—*R. J. Evans.* (Biological Abstracts)

GILPIN, GLADYS L., ELSIE H. DAWSON, EDWARD W. TOEPFER, and HELEN W. WARREN. (U. S. Dept. Agric., Beltsville, Md.)
PALATABILITY AND NUTRITIVE VALUE OF HOME-CANNED CHICKEN PREPARED BY DIFFERENT METHODS FOR PROCESSING. *U. S. Dept. Agric. Tech. Bull.* 1054 1-36. 1952.—Quality detns. included panel evaluations of chicken flavor, juiciness, and tenderness, and chemical analyses for moisture, fat, free fatty acid, ash. and thiamine content on selected samples. Method of prepn. for packing, in some instances, affected the palatability of canned chicken. Chicken packed raw scored as high or slightly higher than chicken precooked in water or in broth, or browned in a fry pan, in the oven, or on a broiler before processing. Canned chicken samples, prepared for packing by pre-

cooking in water or in broth, were similar in palatability to the raw pack. Canned chicken lightly browned in a fry pan before packing rated almost as high as the raw pack when mature hens or cockerels were used; canned young hens browned in a fry pan rated lower. Chicken lightly browned in the oven or on a broiler before packing scored lower than the other packs, particularly on chicken flavor and juiciness. The kind of bird—cockerel, young or mature hen—had little effect on the quality of the canned product. Canned cockerel appeared to be slightly more satisfactory in flavor when browned in the oven before packing than parallel packs made from 6-or 16-mos.-old hens. Intensity of chicken flavor decreased and off-flavors increased as storage time lengthened. Juiciness and tenderness of canned chicken were affected less consistently by storage. Raw-packed chicken appeared to have better keeping quality than either that precooked in water or lightly browned on a broiler before canning. The kind of meat—breast or thigh—influenced scores for all palatability factors studied except off-flavor. Thigh had more chicken flavor and was juicier but less tender than breast meat. The method used for preparing canned chicken for serving—heating chicken in its own juice or frying—affected the palatability of the chicken. Fried chicken was more moist and tender than parallel samples heated in their own juice, and off-flavors were less noticeable in fried samples. Scores for intensity of chicken flavor were similar for the 2 methods of serving. The percentage of moisture, fat, and ash in canned chicken was affected little by prepn. methods. The amt. of free fatty acids in the chicken fat increased somewhat during prepn. for packing, processing, and storage. Thiamine content was approx. the same for freshly canned cockerel and mature hen, ranging from 0.016 to 0.021 mg. per 100 g. edible portion. Chicken packed raw retained more thiamine than that precooked in water or lightly browned on a broiler. For canned cockerel there were some losses of thiamine upon storage for 8 or 12 mos.; for canned hen, no thiamine loss.—*Authors.* (Biological Abstracts)

JENSEN, LEO S., E. A. SAUTER and W. J. STADELMAN. (State Coll. Washington, Pullman.)

THE DETECTION AND DISINTEGRATION OF BLOOD SPOTS AS RELATED TO AGE OF EGGS. *Poultry Sci. 31:* 381-387. 1952.—The age of the eggs and storage temp. affected the efficiency with which blood spots could be detected. For normal candling eggs should be at least 3 days old in order to detect the highest percentage of blood spots present. When eggs are held in storage, small blood spots disappear depending on time and temp. There was no indication that the blood spots changed to meat spots.—*L. S. Jensen.* (Biological Abstracts)

JORDAN, RUTH, L. E. DAWSON, and C. J. ECHTERLING. (Agric. Expt. Sta., Purdue U., Lafayette, Ind.)

THE EFFECT OF SELECTED PRETREATMENTS UPON THE CULINARY QUALITIES OF EGGS FROZEN AND STORED IN A HOME-TYPE FREEZER. II. SPONGE CAKES. *Food Res. 17:* 93-99. 1952.—Egg yolks and whole egg magma, untreated and treated with 2 levels each of salt, sugar, and white corn syrup were frozen and stored for periods up to 6 mo. in a home-type freezer at about 0°F. Untreated frozen yolks were not satisfactory for use in sponge cakes, but untreated whole egg magma was. Cakes made from salt-treated eggs and yolks were too salty in flavor, and cakes made from whole eggs treated with about 5% salt were low in volume. Sugar- and syrup-treated egg magma produced cakes of greatest volume and highest palatability scores. The length of the storage period was not as important as the pretreatments of the frozen eggs upon their leavening property.—*Ruth Jordan.* (Biological Abstracts)

KLOSE, A. A., E. P. MECCHI, H. L. HANSON, and HANS LINEWEAVER. (Western Regional Res. Lab., Albany, Calif.)

THE ROLE OF DIETARY FAT IN THE QUALITY OF FRESH AND FROZEN STORAGE TURKEYS. *Jour. Amer. Oil Chemists' Soc.* 28: 162-164. 1951.—Groups of turkeys were fed for 8 wks. prior to slaughter diets varying in the type of animal protein concentrate (fish

meal vs. meat scraps) and varying in degree of unsaturation and kind of vegetable oil present (coconut oil vs. linseed oil.) Chemical and organoleptic analyses of the fresh and stored carcasses established the following points: (1) Differences in fatty acid composition of dietary fat of turkeys have a marked effect on the fatty acid composition of carcass fat and correspondingly play a decisive role in the storage life of the turkey carcass. (2) Typically fishy flavors and odors in roasted turkey meat, which can be caused by feeding fish (oil) products, can also be produced in the absence of fish products by a highly unsaturated vegetable oil, linseed oil. The fishy flavor is present in the roasted, freshly slaughtered turkey and apparently increases very little if any in intensity during storage.—*Auth. summ.* (Biological Abstracts)

KLOSE, A. A., E. P. MECCHI, G. A. BEHMAN, and HANS LINEWEAVER. (West. Reg. Res. Lab., Albany, Calif.), **and F. H. Kratzer and DELBERT WILLIAMS.** (U. California, Davis.)
CHEMICAL CHARACTERISTICS OF TURKEY CARCASS FAT AS A FUNCTION OF DIETARY FAT. *Poultry Sci. 31:* 354-359. 1952.—Groups of turkeys were fed for 17 weeks on a practical ration, a simplified low-fat basal diet, and a basal diet supplemented with 2% levels of beef fat, corn oil, linseed oil, sardine oil, and soybean oil, respectively. Analyses of the feed fat and carcass fat for their fatty acid contents demonstrated significant correlation between diet fat and carcass depot fat for linoleic acid and linoleic acid contents. The content of total saturated fatty acids in the depot fat was maintained at a fairly constant level by the turkey. There were no significant differences in fatty acid composition between 3 widely separated depots in the carcass. With respect to the unsaturated fatty acids, the fatty acid composition of depot fats of commercially raised turkeys was shown to be largely a reflection of the fatty acid composition of the dietary fat. Depot fat synthesized by the turkey on a low diet was roughly estimated to contain 28% total saturated fatty acids and 68% oleic (and hexadecenoic) acid. Induction periods of the depot fats were correlated in general with fatty acid composition, the linolenic acid content being most influential of contributing toward instability in the groups studied. Depot fat stability was very responsive to dietary fat changes; compared to avg. commercial stability, represented by stock diet or soybean oil groups, the linseed oil and sardine oil, groups were much less stable, while the corn oil, beef fat, and low-fat groups were significantly more stable.—*A. A. Klose.* (Biological Abstracts)

LORENZ, F. W., and PHOEBE BETTY STARR. (U. California, Davis.)
SPOILAGE OF WASHED EGGS. I. EFFECT OF SPRAYED VERSUS STATIC WATER UNDER DIFFERENT WASHING TEMPERATURES. *Poultry Sci. 31:* 204-214. 1952.—Soiled eggs spoiled more frequently in storage than unwashed clean eggs. Bacterial spoilage was increased by washing, regardless of the original condition, but mold spoilage was greatest when eggs were stored with dirt on the shell. Nearly all of the spoilage found immediately after removal of eggs from cold storage was of the fluorescent-sour type, but other types of spoilage became predominate after holding eggs an additional 2 weeks at room temp.—*F. W. Lorenz.* (Biological Abstracts)

LORENZ, F. W., F. X. OGASAWARA, and PHOEBE BETTY STARR. (U. California, Davis.)
SPOILAGE OF WASHED EGGS. III. A SURVEY OF RANCH PRACTICES AND RESULTS. *Poultry Sci. 31:* 221-226. 1952.—Large differences were observed in spoilage of washed eggs from different ranches in the same area. These differences were not closely correlated with any observed features of washing machine operation but the differences appeared to be consistent over extended periods of time in some instances. Dry cleaning produced little or no spoilage in the few samples examined. A limited number of eggs that had been hand washed after brief soaking in alkaline detergent also survived storage satisfactorily, but presoaking heavy dirties prior to machine washing resulted in striking increases in spoilage.—*F. W. Lorenz.* (Biological Abstracts)

MARSDEN, STANLEY J., LUCY M. ALEXANDER, GRACE E. SCHOPMEYER, and JESSIE C. LAMB.

VARIETY AS A FACTOR IN FLESHING, FATNESS, AND EDIBLE QUALITY OF TURKEYS. *Poultry Sci. 31:* 433-443. 1952.—Male and female turkeys, 12 each of Beltsville Small White, Broad Breasted Bronze, standardbred Bronze, and standardbred White Holland vars. 28 and 30 wks. old were graded, roasted, and judged (breast, leg, and skin). The BBB as a var. rated highest in fleshing, or conformation, followed by the BSW. BSW males were outstanding in fatness, or finish. BSW females rated highest in flavor, tenderness, and over-all desirability. BSW and BBB were superior to the other 2 vars. in edible quality. The fatter the turkeys the juicier was the cooked breast meat.—*S. J. Marsden.* (Biological Abstracts)

MARSDEN, STANLEY J., LUCY M. ALEXANDER, GRACE E. SCHOPMEYER, and JESSIE C. LAMB.

STARTING DIET AS A FACTOR IN EDIBLE QUALITY OF TURKEY. *Poultry Sci. 31:* 451-458. 1952.—Fishy and other off-flavors were reported in cooked muscle and skin of all turkeys upon removal at 8 or 9 wks. of age from starting diets containing fish oil and fish meal. Fishy flavor persisted up to 13 wks. afterward, although no fish products were fed in the growing diets; other off-flavors persisted for 18 wks. (end of expt.). Off-flavors sometimes were more prominent in cold samples than in hot. At 16 wks. of age turkeys fed the starter with highest fat content were superior in tenderness and juiciness.—*S. J. Marsden.* (Biological Abstracts)

NORRIS, K. H., and A. W. BRANT. (U. S. Dept. Agric., Beltsville, Md.)

RADIO FREQUENCY AS A MEANS OF GRADING EGGS. *Food Technol. 6:* 204-208. Illus. 1952.—A method is described for measuring the radio-frequency conductivity of highly conducting liquids over a frequency range of 50 kc. to 1000 mc. The conductivity of albumen from low-quality eggs was found to be 8.5×10^{-3} mho per cm. at 22°C. at the lower frequencies with increasing conductivity at the higher frequencies. Yolk material from low-quality eggs was found to have a conductivty of 2.9×10^{-3} mho per cm. at 22°C. at the lower frequences. The conductivity of both albumen and yolk material from high-quality eggs was found to be about 15% lower than the respective values for low-quality eggs. Two electronic candlers using radio frequency were tested and found to be unsatisfactory. It was concluded that with the equipment now available, the interior quality of shell eggs could not be correctly measured with radio frequency.—*Authors.* (Biological Abstracts)

ROMANOFF, ALEXIS L. (Cornell U., Ithaca, New York.)

ELECTRONIC GRADING OF EGGS. *Food Technol. 6:* 236. 1952.—High frequency conductivity measurements on fresh and aging intact eggs are well correlated with the results of some standard methods of evaluating opened eggs, and therefore indicate that electronic instruments (especially if improved in stability) could be used to determine the internal quality of table eggs.—*A. L. Romanoff.* (Biological Abstracts)

STARR, PHOEBE BETTY, F. W. LORENZ, and F. X. OGASAWARA. (U. California, Davis.)

SPOILAGE OF WASHED EGGS. II. LABORATORY VERSUS RANCH WASHING. *Poultry Sci. 31:* 215-220. 1952.—Machine washing of eggs in the laboratory using clean water at 50-60°C. produced no greater spoilage than was obtained in unwashed eggs from the same source. Serious spoilage resulted, however, when eggs were washed on the ranch using similar conditions. Cold water, and 80°C. water caused spoilage even during laboratory washing. Unwashed "light dirty" eggs survived storage as well as unwashed clean eggs.—*F. W. Lorenz.* (Biological Abstracts)

GENERAL

WEISS, H. S., and P. D. STURKIE. (Poultry Dept., Rutgers U., New Brunswick, New Jersey.)
AN AUTOMATIC OVIPOSITION RECORDER. *Poultry Sci. 31:* 234-373. 1952.—A device for accurately recording time of laying of birds in batteries is described and illustrated. Completion of an electric circuit by the laid egg activates the apparatus. The recording is done by teledeltos paper, which is sensitive to electric current of suitable voltage and amperage.—*P. D. Sturkie.* (Biological Abstracts)

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January 1, 1952 to December 31, 1952

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Receipts		
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Advertising	1,389.28	
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TOTAL	$10,378.01	£2150-12- 9
Expenditures		
Printing Journal	$ 2,142.37	
Postage	338.01	£ 19- 3- 7
Translations		4-13- 2
Biological Abstracts	28.00	
Clerical and Administration Expenses	622.60	100- 0- 0
Supplies (letterheads, envelopes, stencils, etc.)	86.61	13-18- 4
Subscriptions to magazines	30.75	
Editor	400.00	
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Congress Reports	10.00	10-19- 0
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TOTAL	$ 8,741.09	£ 743-13- 4
Balance Dec. 31, 1952	$ 1,636.92	$1406-19- 5
Savings Account		
Balance, Dec. 31, 1951	$ 2,435.33	
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	1941-44	1945-48	1949-52
Dairy Products	13	15	12
Meat Animals	38	42	42
Eggs & Poultry	49	61	85

It is also interesting to note that in 1952 the production of eggs and poultry was double the annual average of the 1935-39 period.—Morley A. Jull, University of Maryland.

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[1] See POULTRY SCIENCE, March 1952

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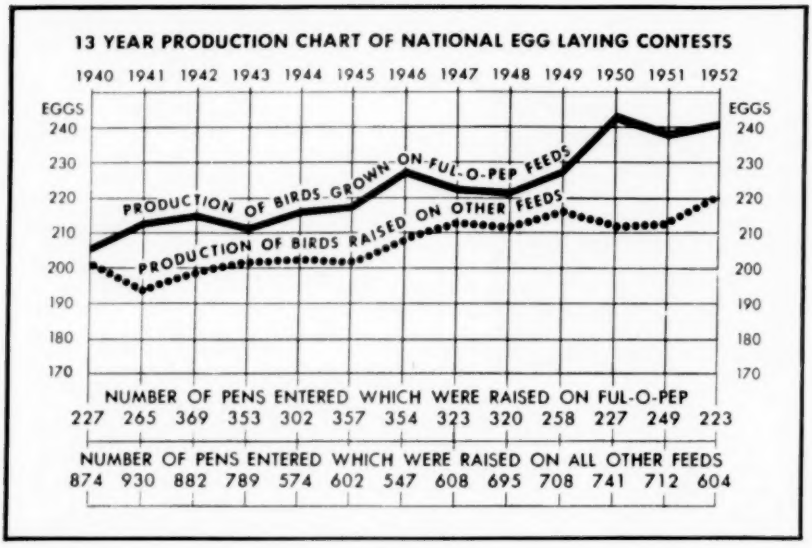
13 YEAR PRODUCTION CHART OF NATIONAL EGG LAYING CONTESTS
1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952
EGGS
240
230
220
210
200
190
180
170
PRODUCTION OF BIRDS GROWN ON FUL-O-PEP FEEDS
PRODUCTION OF BIRDS RAISED ON OTHER FEEDS
NUMBER OF PENS ENTERED WHICH WERE RAISED ON FUL-O-PEP
227 265 369 353 302 357 354 323 320 258 227 249 223
NUMBER OF PENS ENTERED WHICH WERE RAISED ON ALL OTHER FEEDS
874 930 882 789 574 602 547 608 695 708 741 712 604

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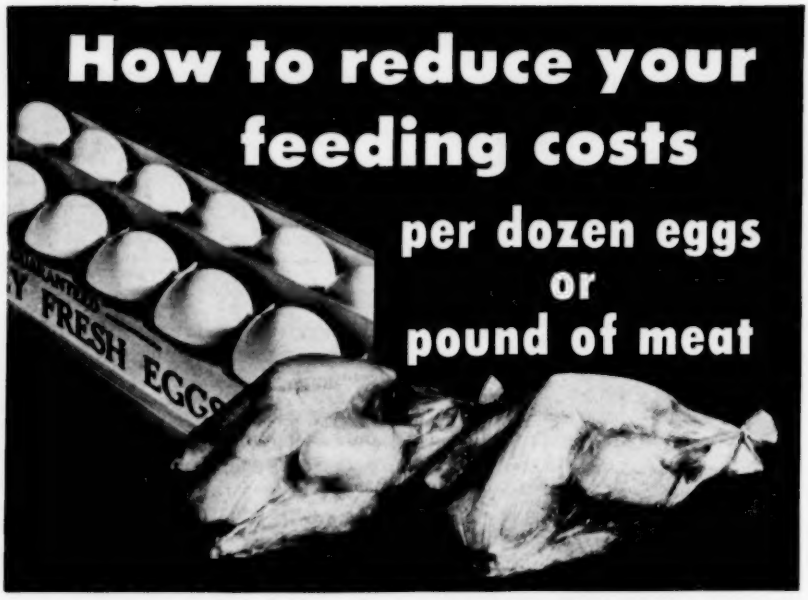

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